. 1806
l. XLIV

FLIGHT

and

The AIRCRAFT ENGINEER

1/-

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

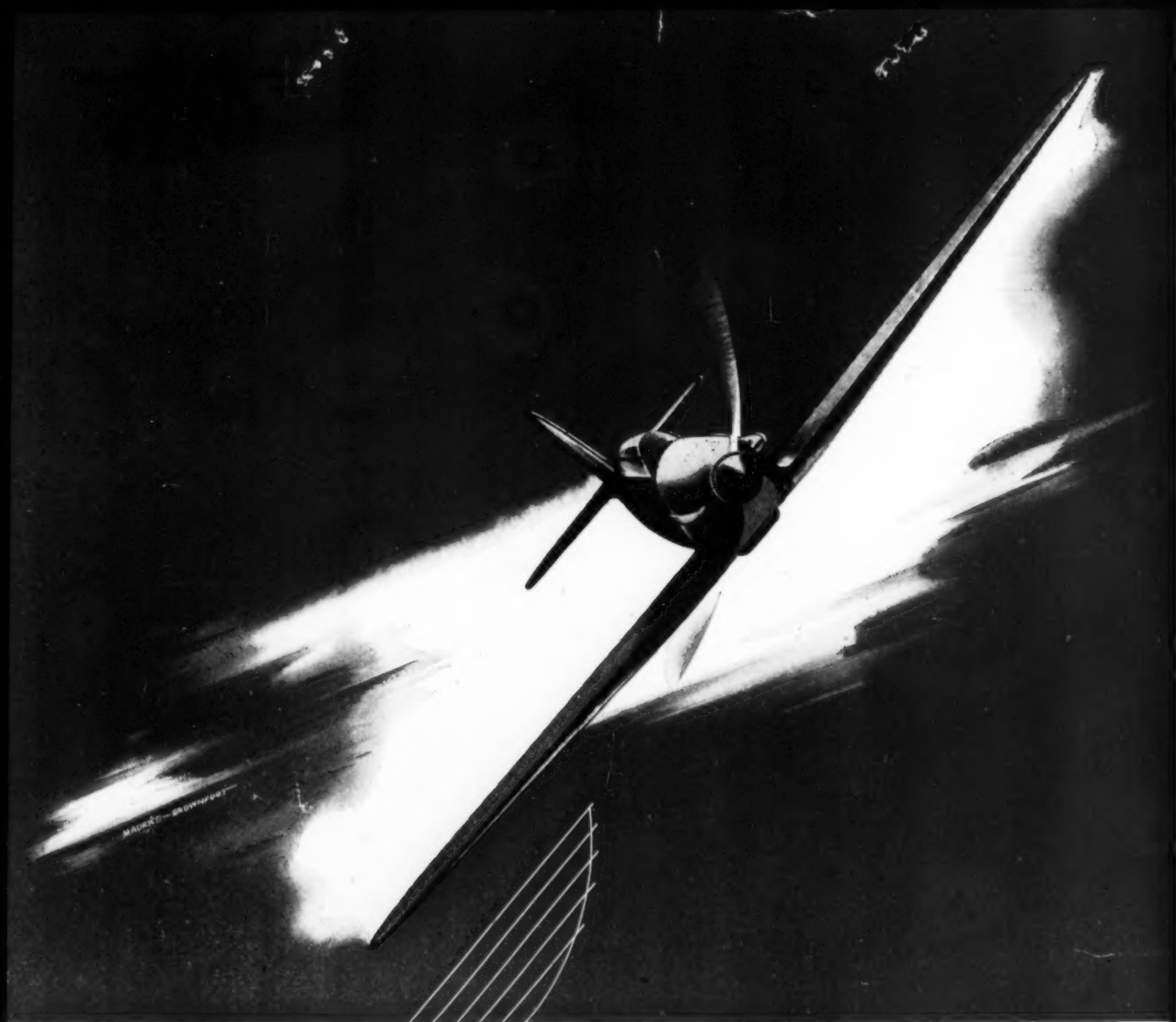
AUGUST 5th, 1943

DOUGLAS AIRCRAFT LIBRARY
AUG 24 1943
DOUGLAS AIRCRAFT CO., INC.

Bearings —
Ball or
Roller —

R & M

TISCO TIMKEN



MORRISONS

CROYDON

CONSTRUCTION, MAINTENANCE AND REPAIR

Smee's

FLIGHT
and
The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH, M.B.E.

Chief Photographer
JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY: 8-10, CORPORATION ST. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.
BIRMINGHAM, 2: GUILDHALL BUILDINGS, NAVIGATION ST. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).
MANCHESTER, 3: 260, DEANSGATE. Telegrams: Iliffe, Manchester. Telephone: Blackfriars 4412.
GLASGOW, C.2: 26B, RENFIELD ST. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

Registered at the G.P.O. as a Newspaper.

No. 1806. Vol. XLIV. August 5th, 1943. Thursdays, One Shilling.

The Outlook

Hamburg

IT is hard to believe that Hamburg will for a long time to come be able to turn out many U-boats fit to take part in the Atlantic battle. It has had a most terrific hammering by day and night, with practically no period of rest allowed to it. Nothing like this succession of blows has ever taken place before.

A while ago Bomber Command devoted a great part of its attentions to the bases on the Bay of Biscay, from which most of the U-boats set forth after assembly or repairs, but the results did not seem, so far as lay observers could judge, commensurate with the effort. U-boats still set forth into the Atlantic, though perhaps in smaller numbers than if their lairs had been undisturbed. The repair pens were practically bomb-proof, and it was on the upsetting of shore facilities that the chief hopes were hung. At that time, however, the Allied successes in the Battle of the Atlantic were due to sinking the boats in the vicinity of the convoys rather than in their lairs. Fortunately, an almost crippling number of them were so sunk.

The result, naturally, was that the German Navy needed, not repairs, but new boats, and for them it looked mainly to Hamburg. By this time Air Chief Marshal Harris has a very large force of heavy bombers at his disposal. The science and art of bombing have been carefully studied and developed for years past. Bombing is a difficult operation of war, so the Air Chief Marshal has written in the foreword to a book, and one of the most important points is to cut down the time taken for a raid. It is worth while saving even five minutes, and the staff of the Command had to exercise all its well-tried ability to reduce the 50 minutes taken on the great raid of July 24th to 45 minutes on the even greater raid of July 27th. The losses of our bombers per ton of bombs dropped steadily diminishes, and the crews of the A.A. guns evidently suffered heavy casualties. The concrete results, we may all hope, will be seen in a shortage of U-boats in the Atlantic.

Magdeburg

ANOTHER most satisfactory sign of the increasing power of the Allied bombing offensive was the daylight attack by Fortresses of the U.S. Army Eighth Air Force on an aircraft assembly plant near Magdeburg, which is less than 100 miles south-west of Berlin, and on an aircraft factory at Kassel, nearly 100 miles east of the Ruhr. Hitherto that Force had been feeling its way forward by raids, always by day, on places in occupied territory or on the coasts and borders of Germany. Major-General Eaker not long ago explained in an interview that he would not risk losses of aircraft at a rate greater than the possible rate of replacements, but added that as his strength increased his bombers would penetrate deeper into Germany. He has now begun to make his promise good.

The degree of risk run by a bomber varies with the length of time it spends flying over a defended area, and it needs little power of imagination to picture the perils of such long flights as those mentioned. Compared with the Lancaster, the bomb load of the Fortress is light, but precision bombing by daylight means that each bomb dropped does the maximum damage to the target, and the Americans claim that this method is more economical and comparatively more effective than the area bombing by night undertaken by the R.A.F. At any rate, these two raids were extremely gallant feats by the Americans, and with the many made on other targets form a valuable complement to the raids by the R.A.F. We all look forward to hearing of many more of the same sort as the strength of the Eighth Air Force continues to grow.

"United by Air"

BRITISH EMPIRE aviation has no stronger advocate than Viscount Bennett. Whenever the opportunity occurs he can be counted on to impress upon his audience the vital necessity of a strong post-war aviation policy. Last week, when speaking to the London Association of British Empire Newspapers Overseas, Viscount Bennett again stressed the need for calling immediately a conference of representatives from all parts of the Empire, and for building British civil aircraft now. If we did not do so we might find we had won the war and lost the Empire.

Those are strong words, but not too strong. As Lord Bennett said, the partners in the British Empire are divided by land and sea. They can be united by air. We would go farther. We would say that they can *only* be united by air.

"Stewing in Their Own Juice"

MR. CHURCHILL once said, quite rightly, that he considered it justifiable to deceive the enemy. These words must be borne in mind as one reads his speech in Parliament on July 27th.

Allowing for this proviso, the Prime Minister for once seemed to indicate in his speech what the military operations of the United Nations in the Mediterranean would be in the near future. Mr. Churchill threatened Italy with "the maximum avalanche of fire and steel upon all targets of military significance," and then went on to point out to the House of Commons all the disadvantages which would ensue from a formal invasion of the Italian mainland. He proposed to let the Italians "stew in their own juice" for a while.

The prospect before Italy, therefore, is naval blockade, amphibious operations, and, above all, ceaseless bombing of military targets. In this case the bomber gives to the United Nations the ability to inflict upon a hostile Power, whose will to resist is palpably waning, the maximum degree of pressure. Bombing, though restricted to factories, harbours, communications, and suchlike, brings home the unpleasantness of war most acutely to all within sight and hearing of the raids.

Our great object must be to get to grips as soon as possible with the German armies on the mainland of Europe. If we can do that without wasting time by occupying Italy, so much the better.

CONTENTS

The Outlook	133
War in the Air	135
Here and There	138
The Horten IV	139
Democratic Document	141
Behind the Lines	143
Aircraft Characteristics	144
Topics of the Day	146
Type-testing the Jumo 211D	147
Albacores in Malta	148
Plywood and Plastics—III	150
Correspondence	155
Service Aviation	156

"Flight" photograph.

MITCHELLS OVER BRITAIN: North American B 25s (Mitchells) of the Royal Air Force in formation above the clouds. The Mitchell is the only twin-engined bomber to have taken off from a carrier's deck. Sixteen of them did this on the occasion of the bombing of Tokyo.

WAR in the AIR

Reinforcing Sicily : Slaughter of German Transporters : Air War in the Pacific

WHERE THE ROADWAY ENDS: Douglas C.47's at the Chinese terminal of the aerial Burma Road.

VETERANS of the last war remember the unpleasantness of their sensations when ordered to make a frontal attack on German trenches, if they doubted whether the wire had been successfully cut and the machine guns properly knocked out by the artillery, but those feelings can be nothing like so depressing as what must be felt by German soldiers to-day when ordered to crowd into a Ju 52 in Italy for transport to the north-east corner of Sicily. The men must be mainly infantry, and they may never have been in the air before. Even in peacetime, a first flight is often something of an ordeal. It must be far more terrifying a prospect when one knows that Lightnings and Spitfires frequent the air on the way, and that no escort can ensure safety for the air transporters. Not long ago, on July 18th, 15 of these Ju 52 machines set out, but were intercepted by Lightnings, and every one was shot down by the Allied fighters into the Tyrrhenian Sea. Again on July 25th a large formation attempted the crossing, but was caught by Allied fighters when near Messina (so near and yet so far) and 21 of them went down to either a fiery or a watery end. On the latter occasion the Junkers had an escort, but five of their would-be protectors also fell to the guns of Allied fighters.

THE LOW DOWN FROM THE HIGHER UPS: Air Marshal Coningham giving a "gen" talk to men of the North African Tactical Air Force under his command.

Experience has shown, however, that we cannot build up a wall in the air by night as well as by day, and that the Germans were able to get reinforcements across a narrow sea if they were willing to face losses. The distance is short, and both aircraft and ships can elude our watchfulness in small numbers, though it is extremely unlikely that heavy guns or tanks can be got into the island. However, the Germans contrived to replace the quarter-hearted Italians on the north-western sector of the perimeter round Mt. Etna and Messina. A few more enemy raids on Malta have taken place, but that gallant island need no longer be regarded as the centre of our air offensive against Italy. Sicily itself, so long the tormentor of Malta, is now the base for the offensive by

WAR IN THE AIR

fighters, fighter-bombers, and light bombers. The heavies, of course, can still work from bases in the Middle East and North-West Africa; in fact bombing raids on Italian ports are now sometimes mere incidents in flights between Britain and Africa.

In the various African campaigns, of which the invasion of Sicily is a direct sequel, aircraft have many times been used as field artillery when it was not possible or easy to get the guns into position in time. It is not the ideal thing to do, but it is a useful expedient on occasions. When the artillery can be brought into play in sufficient force it is best to leave the battering work to them, for it is their proper job. Best of all is a combination of guns and bombers such as was seen in the later stages of the fighting in Tunisia, each doing its own share of the work, and not interfering with the other.

The Allies are free to land guns in Sicily, for they hold command of both sea and air, and have good ports at their disposal, but it is doubtful whether they have yet had time to get large quantities into the island and up into position on the fighting front. Time is of importance to General Eisenhower and his men, for obviously the Germans are merely fighting to gain time and their object ought to be frustrated. There is lots of work for the armies from Africa to do elsewhere once Sicily is completely in our hands.

Therefore it seems probable that the final blow which will break the German ring round Catania and Messina may be struck by the aircraft of the Allies. In fact, that may have happened by the time these lines are published. No air opposition of any account need be feared, for the Germans are very short of fighters and have withdrawn most of those which they had massed in Sicily—that is to say those which survived, but their losses have been heavy—and the British and American machines of all classes are free to rove whither they like and to strike at positions as well as at communications. The German field force, unbacked by fighters, is in a position comparable to that of H.M.S. *Prince of Wales* and *Repulse*, though their destruction may take somewhat longer to accomplish. Torpedoes do their work quickly, but they are not for use on land, and defensive positions in mountainous country are the least susceptible of all to destruction by bombs. Still, if the forward positions can be isolated by day, and perhaps to some extent by night, the task of the Allied infantry will be enormously simplified.

Meanwhile, the abolition of the Fascist party by Marshal Badoglio looks like an attempt to appeal for easy terms so soon as Italy ceases to be held down by the German garrison. The repetition of the phrase "The war goes on" has no sound of expectation of victory.

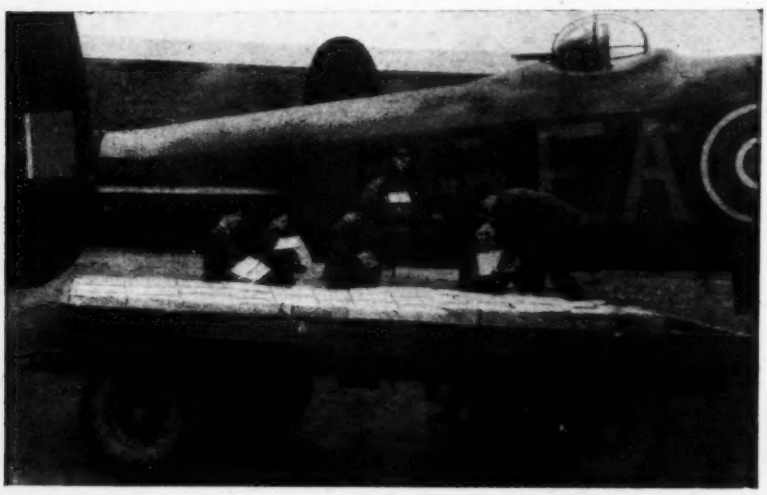
Forward in the Solomons

GENERAL MACARTHUR has been feeling his way cautiously forward in New Georgia towards the great Japanese air base at Munda. He is using both infantry and aircraft, and it does not appear from the reports that he has much artillery in action, except when his warships bombard a position. Time does not seem of first-rate importance to the Americans and Australians, so long as they can hold off the threat to Australia, which is now negligible, and gradually make headway. The grand attack on Japan will come later; at the moment it is of more consequence that the progress should be made with the least possible expenditure of Allied lives. So the American bombers, of which there are a great variety of types in the area, are kept busily employed. Munda has been heavily bombed over and over again, but it seems to resemble Stavanger in its power of survival against attack from the air. The Japanese defence against infantry advance consists mainly of innumerable machine-gun posts cleverly placed and most resolutely manned. The proper way of dealing with machine guns is by sending tanks against them, but this is not feasible in island warfare. Bombs are the best weapons available, but they are not ideal for blotting out small and well-concealed targets. They can wreak havoc in camps, and they have taken a very great toll of Japanese shipping, but against machine-gun posts direct hits are all that can do any good, and direct hits must be more a matter of good luck than good guidance. The Japanese, unlike the Germans in Sicily, can bring defending fighters into play.

A new move in the Pacific war has been a series of American bombing attacks on Wake Island, one of the chain of American island bases which the Japanese seized in their first impetuous attack. Kiska, in the Aleutians, has become a regular target now that summer weather has come, and there seems little doubt that the Americans intend to recapture it as they have recaptured Attu. Its capture will remove a remote threat to the American continent, but will not provide a base for bombing Japan.

In Burma the R.A.F. and Americans have continued their air operations against the Japanese in spite of the monsoon. Vengeance dive bombers

EXPLOSIVE THISTLEDOWN: Parachute bombs dropped by U.S.A.A.F. Mitchells during an attack on a Japanese airfield.



BACK TO NICKEL RAIDING: Loading leaflets into a Lancaster of a Rhodesian squadron before one of the big raids on Hamburg. Over 2,000 tons of bombs were dropped at the same time to emphasise the message in the leaflets.

WAR IN THE AIR

have been used with effect, while there has also been mention of old-fashioned Mohawks. Doubtless they are good enough for the work required of them. The tardy appearance of the Vengeance dive bombers, first ordered by the R.A.F. in the summer of 1940, is rather amusing. Evidently the Air Force under Air Chief Marshal Tedder does not want them.

The week-end brought good news for the United Nations from all fronts. American Fortresses bombed Kiel and the Heinkel factory at Warnemunde by daylight with small losses to themselves. The Russians pressed on round Orel in a series of skilful thrusts which baffled the Germans. In Sicily the American Seventh Army captured the important road junction of Nicosia, and the Canadians made a further advance. Every day fighters and fighter-bombers, often accompanied by light bombers, swept over occupied territory and damaged targets and rolling stock. In one day four Blöhm and Voss 138 flying boats were shot down into the North Sea, two by naval Martlet fighters and the other two by Coastal Beaufighters.

Though the Alert sirens sounded more than once in the London area and elsewhere in Britain, very few enemy raiders crossed the coast, and in the week from July 21st to 28th not a single person was killed or hurt by German bombs. Of those few raiders 15 per cent. were shot down. On the other hand, during the same period Bomber Command dropped some 7,000 tons of bombs on Hamburg, Essen and other places in Germany, losing less than three per cent.

THE ABOVE HAVE ARRIVED : Two photographs taken during a Fortress attack by the U.S.A.A.F. on the aluminium factory at Heroya, in Norway.

YOUTH TO THE FORE

Bristol's New Chief Designer

AT the age of 39 Mr. A. E. Russell, B.Sc., F.R.Ae.S., whose promotion from deputy chief to chief designer, aircraft, has just been announced, is one of the youngest chief designers to any large, old-established British aircraft firm. Mr. Russell joined the Bristol Aeroplane Co., Ltd., in 1925 as a technical assistant in the stress office. He became chief stress calculator in 1927 and chief technician in 1930, under the late Capt. Barnwell.

Mr. A. E. Russell.

In 1938 Mr. Russell was responsible, as technical designer, for all stress and aerodynamic calculations, mechanical testing and structural research. This work led to the production of the first Bristol stressed-skin aircraft, the Bombay troop carrier, of the Bristol *Britain First* from which afterwards the Blenheim was developed, and of the Beauforts and Beaufighters that have made and are daily making history. In 1940 Mr. Russell became deputy chief designer under Mr. L. G. Frise, a post which he has occupied until his recent promotion to chief. Mr. Frise becomes the Bristol company's chief engineer, aircraft.

Apart from his design work Mr. Russell has served on many technical committees, including the British Engineering Standards Association and the technical committees of the S.B.A.C.

We recall with some pride that Mr. Russell has contributed several valuable technical articles to *Flight*.

A.T.A. BENEVOLENT FUND

SUBSCRIPTIONS to this deserving fund are still urgently wanted. They should be sent to the Hon. Treasurer, A.T.A. Benevolent Fund, White Waltham, Maidenhead, Berks. The latest list of donations appears below :—

Donations as per previous statement	£6,495	19	7
Chance and Hunt War Charities Fund	4	0	0
Rivington and Blackrod Grammar School		15	0
Robert Ross and Co., Ltd.	25	0	0
S. G. Galsworthy	3	0	0
Spong and Co., Ltd. ..	5	0	0
H. Winten, Ltd.	5	5	0
Suflex, Ltd.	5	5	0
J.U.H. Corporation	5	5	0
A. J. Balcombe, Ltd. ..	5	5	0
Spikins (Twickenham), Ltd.	10	10	0
G. Biddles, Durion, Ltd.	10	0	0
A. Wells and Co., Ltd.	5	5	0
Whiteley Electrical Radio Co., Ltd.	5	5	0
Martin Baker Aircraft Co., Ltd.	25	0	0
C. S. Shermule	2	2	0
Wadham Bros.	2	2	0
	£6,614	18	7

HERE AND THERE

GRIM GAIETY : Four wing-cannon instead of machine guns is the latest armament applied to the Mustang. This one is being used for an experiment in camouflage, the idea being that the jazzy finish will confuse enemy air-gunners ; it looks as though it might even blind them !

Sicilian Shuttle Service

R.A.F. Transport Command aircraft are ferrying troops and equipment to Sicily and returning with Allied casualties, states the Air Ministry.

These aircraft were among the first to land on the island and take off again.

Bigger and Bigger

AIR experts in Washington have announced that far bigger and more powerful bombers than the latest Fortresses may be in action by the autumn. It is stated that 8-ton bombs are already in existence.

R.C.A.F. Women Recruits

THE Royal Canadian Air Force women's division is recruiting in Britain a number of English girls who have married Canadian airmen. According to the Air Ministry some of the women are widows of Canadians killed in action.

There are vacancies in many trades which are now closed to the W.A.A.F.

Soviet Women Parachutists

RUSSIAN women parachutists are in action on the Donets sector, according to a report from Berlin.

It is said that the women, after being trained in the use of arms, are sent out to reconnoitre the German positions. They then mobilise guerilla troops who attack the Nazis from the rear.

America's "Gold Coast"

HERE'S a smile from the house organ of a San Diego aircraft factory: "A guy from Kansas came to the coast and got a good job in one of our airplane plants. Shortly he sent this message back: 'Wish you were here. Having wonderful time and a half.'"

U.S. Transport Aircraft

IT is announced that the first four-engined transport aircraft produced at the £8,000,000 Chicago plant of the Douglas Aircraft Co. will shortly make its inaugural flight. This is the C.54 Skymaster, which will carry 15 tons of arms, equipment and supplies, or 50 fully equipped and armed soldiers.

The Skymaster is the largest type in full-scale production.

Express Delivery

THE first transatlantic flight in the Canadian Government's new wartime transocean service was accomplished recently. The aircraft made a non-stop flight to this country from Montreal in 12 hours 26 minutes, and carried 23 cwt. of mail and three passengers.

The service was started mainly to carry mail to and from the Canadian Forces in the United Kingdom, and official passengers.

Firmly Rooted

IT is announced that Sir William Rootes, K.B.E., has been appointed chairman of Humber, Ltd., and subsidiary companies (Hillman, Sunbeam-Talbot, Commer and Karrier) in succession to Lt. Col. J. A. Cole, O.B.E., who has retired, and that Mr. R. C. Rootes has been made deputy chairman of the companies.

Fast Work

UNITED STATES ARMY engineers have turned over another big bomber base, the third within two months, to the Eighth Air Force. It took them only 89 days to clear the land, lay out the runways and taxi strips and make the field ready for bombers to take off for the Continent, thereby breaking their own records for speed in construction.

Brig. Gen. C. R. Moore, chief engineer for the Army in the European Theatre of Operations, made the formal presentation to Brig. Gen. R. C. Candee, chief of the Eighth Air Force Support Command.

Post-war Flying in India

SAYING that the question of convening an Empire Air Conference was now under consideration, Sir Gurunath Bewoor, Secretary of Posts and of the Air Department, recently told the Central Assembly at New Delhi that there had already been an exploratory provisional exchange of views between the Government of India and the British home Government.

New Lodestars for C.P.A.

THE important part played by Canadian Pacific Airlines in the ever-expanding war projects of Northern Canada has resulted in the Joint Aircraft Committee at Washington allocating three new Lockheed Lodestars to them.

These additions to the C.P.A. fleet recently arrived at Edmonton, where they are to be based, in order to supplement the services on the Edmonton-Whitehorse and Vancouver-Whitehorse routes, two of the most active air routes on the North American continent at the present time.

West Indies Extension

BRITISH WEST INDIES AIRWAYS, which was formed in 1940 at the Government's request, is now to extend its service to Haiti, Jamaica, and the Bahamas.

The service began between Trinidad and Tobago, and extended to the Windward and Leeward Islands. Washington has recently granted a temporary permit to fly to Miami via Jamaica and Nassau.

It was announced in the July 22nd issue of *Flight* that K.L.M. was also to inaugurate a service to Miami from Curaçao, in the Netherlands West Indies, with two routes taking in Haiti, Jamaica, and Cuba, so this part of the world will be very well served by air communications.

Air/Sea Rescue Record

LAST week, during the intensive bomber offensive by British and American aircraft, no less than 101 airmen were rescued from the North Sea by the Air/Sea organisation within 50 hours.

During that time more than 200 R.A.F. machines were engaged in searching and protecting the rescue craft. Several airborne lifeboats were dropped by parachute.

B.O.A. Flying Boat Accident

FLIGHT records with regret the disaster to the British Overseas Airways Sunderland flying boat which crashed on Mount Brandon, 14 miles from the little seaport of Dingle, County Kerry, at 4.30 a.m. on Wednesday, July 28th.

Nine of the 18 passengers and the captain of the flying boat, Captain T. Allett, were killed. The remaining nine passengers and six members of the crew were all injured, some so seriously that recovery seemed doubtful.

The Sunderland had left Lisbon the previous evening for Foynes, and the spot where the accident occurred was only some 50 miles or so from its destination. Pending the findings of the inquiry which follows such accidents, it is not yet possible to say more than that it was reported to have happened during a thick fog.

The Horten IV

An Amazing German Tailless All-wing Glider

WITH jet propulsion and power plants of the turbine-compressor type promising to occupy a prominent position in the post-war development period, the problems of the tailless type of aircraft are likely to come to the fore once more. For a single-engined layout the tailless arrangement has the advantage that the single jet can be located to issue exactly on the line of drag so that there is no difference in trim between "engine on and engine off," and the question of airscrew clearance does not arise.

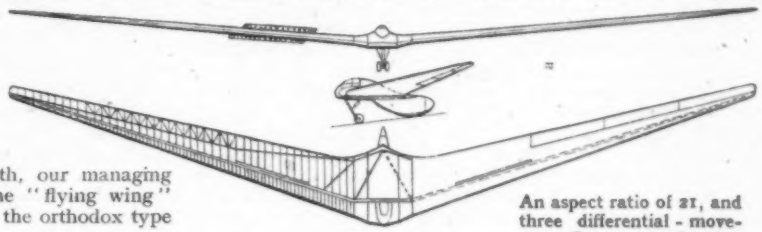
Some Definitions

Some weeks ago (May 27th, 1943) we described some of the trials and tribulations of that British pioneer of the tailless, Col. J. W. Dunne, whose monoplanes and biplanes were flying in the years 1911-14. In our issue of May 13th, 1943, Mr. G. Geoffrey Smith, our managing editor, examined the combination of the "flying wing" and the gas turbine, which may become the orthodox type of aircraft in the future.

Here it might be pointed out that there appears to be some confusion in the minds of many between the expressions "tailless" and "flying wing" or "all-wing" aircraft. The first expression is, of course, clear enough, being fully descriptive of the type of aircraft meant. The other two expressions are used interchangeably, both meaning an aircraft in which there is no fuselage, the crew, passengers and cargo being housed inside the wing. The Germans use the word *Nurflügel* for this type. The word literally means "wing only," so that the closest euphonious translation would appear to be "all-wing" aircraft. "Flying wing" has come to mean the same thing, but it is not so precise, since any wing is a flying wing.

From the foregoing it will emerge that a flying wing or all-wing aircraft need not necessarily be tailless. The tail could be carried on thin tail booms acting merely as beams, the crew and cargo being accommodated inside the wing. Conversely, the tailless need not necessarily be an all-wing aircraft. The Dunne machines, for example, were tailless, but they were not all-wing aircraft since the pilot was seated in a nacelle, this being necessary because the wings themselves were of the very thin sections used in those days, which had to be braced externally by wires.

In Germany many attempts have been made to design tailless gliders and power-driven aircraft, some with a fair degree of success. The most ambitious and difficult task which a designer could set himself in this particular direction is the all-wing tailless single-seater glider. He is trying to reconcile two almost irreconcilable features. The fact that there is but a single seat means small size, and therefore little space in the centre of the wing if fairly normal proportions are to be maintained between wing thickness and wing chord. On the other hand, a high aspect ratio is needed if induced drag is to be kept down. This means an even smaller centre chord than in a low aspect ratio wing.



An aspect ratio of 21, and three differential-movement flaps on each wing are the main characteristics of the Horten IV.

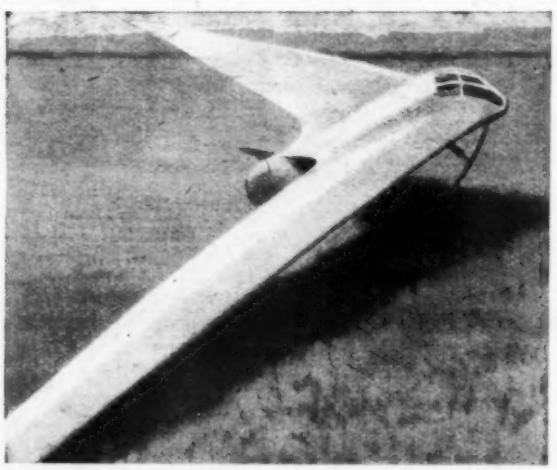
In their type IV the Horten brothers went just about as far as possible in combining high aspect ratio with the all-wing ideal. The aspect ratio is almost fantastic at 21. But that it paid is proved by the fact that the Horten IV glider once remained aloft for 9¾ hours, soaring in thermal currents. That would not have been possible unless the gliding angle had been flat and the sinking speed low. The actual figures for the glider are: Gliding angle 1 in 37; sinking speed 0.5 m. (1.64ft.) per second.

Not Quite the Ideal

Purists may argue that the Horten IV is not truly an all-wing glider since the pilot's cockpit does form something of a bulge on the nose of the wing. For all practical purposes, however, the term may be applied. It would probably have been possible to do away with the bulge altogether, but the pilot's position would have been extremely uncomfortable, and the wing spar would have had to have an elaborate and heavy centre to admit the pilot's body. Even as it is, the pilot occupies a more or less kneeling position. Inside the transparent covering he looks, in fact, not unlike a praying mantis; and experience in Germany proved that it was not until he had suffered for some 50 flying hours that this unusual position became comfortable! Truly the Germans are a patient race.

In any tailless type of aircraft the problems of stability and control are more difficult than in the orthodox type. The "lever arm" of the elevators is short, so that this defect has to be counterbalanced by making them very effective or else of large area, although the shortness of the whole machine reduces the moment of inertia and thus helps matters a little.

Directional control is another snag. In the Dunne biplanes there were vertical surfaces between upper and lower wing tips, but in a monoplane it is customary to rely on the lateral control to steer the machine by banking it. It would, of course, be possible to fit vertical fins and rudders near the wing tips, but presumably they would cause a certain amount of extra drag, although they might have the effect of increasing the effective aspect ratio, just as do the fins at or near the tips of a tailplane on the orthodox type of aircraft. If they were used it would seem advisable to make them "drag rudders" by so arranging matters that the rudders moved outward only. In that way it would not matter greatly how large a rudder angle was required. The surface would act to some extent like an ordinary rudder, since it would be behind the c.g., and at larger



For practical purposes the Horten IV is an all-wing type, the pilot's compartment permitting a kneeling position only.

THE HORTEN IV

angles the drag of the rudder would cause the machine to turn in the desired direction.

It may be recollected that in the Focke-Wulf "Ente" tail-first machine there were fins on the wings, towards the tips, and a large central rudder on the stern of the fuselage. (The machine was twin-engined.) The fins were slightly "toed-in" and were intended to improve directional stability.

In the Horten IV the designers have avoided the need for vertical surfaces by a clever arrangement of their trailing-edge flaps. Evidently, however, they found from experience that this arrangement was not entirely satisfactory in all circumstances, for they fitted in addition drag rudders of an unusual type. Towards the wing tips they placed on the leading edge hinged surfaces which normally fitted the curvature of the wing nose closely. For steering, these surfaces opened out, book fashion, when operated by the pilot via a foot bar.

The "praying mantis" position of the pilot presented something of a problem when it came to choosing the type of control column used. Finally, the "spade grip" type of control was chosen, rocking of the grip working the flaps as ailerons, and to and fro movement operating them as elevators.

Reference has been made to the fact that controllability is always something of a problem in a tailless aircraft. In the Horten IV a very interesting, if somewhat complicated, system is used. On each side there are three trailing-edge flaps, all capable of differential action as well as of working in unison. This complicated system has been rendered desirable, if not indeed absolutely essential, by the combination of the tailless feature with a high aspect ratio. Designers of future tailless types will do well to bear this fact in mind.

In orthodox aircraft the adverse yawing moment set up by the ailerons is fairly easily counteracted by giving "opposite rudder." In the Horten IV it was evidently desired to use the leading-edge drag rudders as little as possible, and so the yawing moments of the ailerons had to be kept down to the lowest possible value. To this end the outer flaps (i.e., those nearest the wing tips) have horn balances which come into action for a small upward deflection of the flap. These flaps, for small angles, act as elevators; at greater angles, when used differentially, they act as ailerons.

The inner flaps (those nearest the wing roots) are used partly as ailerons and partly as elevators, while the middle flaps serve mainly as elevators. The arrangement is, however, complicated by the fact that the inner flaps are used chiefly as negative elevators, while the middle flaps are mainly positive elevators. It has been found that this arrangement ensures the most effective elevator control and preservation of the dihedral with negative elevator. With "starboard elevator up" and "port elevator down," the wing-root flaps also have an aileron effect, in which the tip flaps take part at varying angles of deflection, i.e., with positive elevator the flap angle increases towards the tip and vice versa. This differential action reduces yaw and is assisted by the horn balances of the wing-tip flaps. Great care has been taken to eliminate backlash in the control system.

In addition to rudders and flaps, the Horten IV has air brakes of the slatted type, except that the openings are circular holes and not actual slits. They move out at right angles to the wing surface. When fully extended the air brakes give a sinking speed of 8 metres (26ft.) per second within the speed range of 50-90 km./h. (31-56 m.p.h.). This enables a very steep approach to be made. The maximum diving speed with air brakes extended is 180 km./h. (112 m.p.h.).

The undercarriage of the Horten IV comprises two skids in tandem for taking off, the front skid is placed on two wheels which, however, drop away as soon as the glider is airborne and the skid is retracted.

Main data relating to the Horten IV tailless all-wing glider are as follows:—

Wing span: 65.6ft.
Wing area: 206 sq. ft.
Aspect ratio: 21.
Empty weight (equipped): 528 lb.
Loaded weight: 770 lb.
Wing loading: 3.75 lb./sq. ft.
Best gliding angle: 1 in 37.
Sinking speed: 1.64ft./sec.

The information on which the notes on the Horten IV are based is an R.T.P. translation supplied by M.A.P.

CEYLON AIRFIELD: When war broke out in the Far East, Ceylon quickly became part of the front line of air defence. The building of new airfields from the jungle became imperative. The latest machinery was employed side by side with elephant labour to clear the sites. Thousands of native labourers followed, clearing and levelling the airfields until these sites were ready for final consolidation by heavy steam-rollers. Work was of such urgent character that one airfield was ready for use within a fortnight of work beginning.

Democratic Document

Truman Report Reviewed : Frontal Attack on Production Weaknesses, but Credit Where Due

SOME details of the findings of the Truman Committee were published in *Flight* of July 22nd. We are now able to give our readers a more comprehensive review of this remarkable document, the full text of which has now reached this country. "The Additional Report of the Special Committee Investigating the National Defence Program," or better known as the Truman Report, after its chairman, Senator Harry S. Truman, of Missouri, is the result of exhausting investigation into the different aspects of American aircraft production.

What strikes one immediately is the extraordinary frankness with which the mass of intricate problems is tackled. In fact, it is a frontal attack on delays and inefficiency, ruthlessly attempting to show up the bottlenecks in which some sectors of the war effort are being strangled. And with the object of increasing even further the U.S. production, the questions of prestige and interests are ignored, and the disclosure of deficiencies limited only by considerations of national security.

The advantage so far gained by the Allies in the accretion of air power is summed up in the following opening statement of the report:—

"We have succeeded in building an air industry in the U.S. which our foes cannot hope to equal. England has a splendid aircraft industry, and Russia, about which little is known, is producing large numbers of planes. The German aircraft industry has suffered heavily from the bombing of Germany and is limited as to certain vital supplies, both for the construction and the operation of planes. The Japanese aircraft industry never had a capacity comparable to ours. To reach a production remotely comparable with our own it would be necessary for Japan to expand her industrial resources from the ores to the finished products. . . . Consequently we can be certain that we will be able to oppose Japan with incomparably superior air power. Our difficulties will be those of obtaining bases from which to operate against the Japanese and in overcoming the tremendous advantage which they have gained by acquiring numerous such bases in the islands of the Pacific."

Annual Output

The figures quoted by the report justify the view taken on American production capacity: "During the calendar year 1942, approximately 48,000 airplanes were produced in the U.S. During the twelve months ending June 30th, 1943, we have produced 64,000 planes. The present enormous rate of production will be vastly increased."

At the same time it is emphasised that "there is, and of necessity must be, an extended time lag between the production of a plane at the factory and the actual use of the plane at the front."

To avoid the serious drop in production which usually accompanies a rapid expansion of plants during the transition period, special "modification centres" have been established. In these, aircraft are being made suitable for use at the front until such time as the aircraft plant has had an opportunity to make orderly plans to incorporate the modifications into its production lines.

A feature of this policy was the large variety of aircraft types produced since the established companies were encouraged to produce whatever they could in order to get quantity production with minimum delay. The Committee believes that a great mistake was made in adopting such a policy and that the number of models should be reduced and production concentrated on types which have proved their worth. At the same time "experimentation should continue for the purpose of developing and proving new models, but we should not attempt mass-production of an entirely new model incorporating a whole series of major improvements until after it has been tested and proved."

The labour problem, which many aircraft plants had difficulty in solving, is described by the Committee as being due either to unco-ordinated call-ups, balancing a grading of wages according to responsibility, or to competition in the labour market by offering higher wages in the neighbouring industries. On the other hand, cases are recorded where there was enormous waste of manpower, due to a variety of reasons; but with a better flow of materials and improvements in production organisation this waste has decreased and will decrease further. Two conclusions are most significant and noteworthy: while enforced idleness (it is said) led the workers to suspect sabotage and decreased their efficiency, in plants producing aircraft with a good fighting record the workers were more efficient than in those which were producing inferior types.

Comments on Types

The comments of the report cover almost the entire range of aircraft in production. In *Flight* of July 22 the Committee's views on the Martin B-26 Marauder were reported. Of the other twin-engined bombers the Douglas A-20 Havoc is described as "one of the best liked planes that has been built," while the Martin A-30 is "a less satisfactory but usable plane which has been in production since early in the programme."

The twin-engined fighter of the Army, the Lockheed P-38 Lightning, is described as "a very fine plane in large numbers," while the production of the Northrop P-61, intended for night fighting, is said to be far behind schedule.

Discussing the single-engined fighters, the report states that Army Air Force authorities were slow in recognising the value of high-altitude fighters such as the Republic P-47 Thunderbolt, and they had a definite predilection for the fighters employable at low altitudes in co-operation with large land armies locked in combat. For this reason the Curtiss P-40, which it is admitted has performed valuable work, in the Committee's opinion "was relatively obsolete when we entered the war and of more limited value than other fighters produced by other American companies and by the British."

Another argument in favour of the continued mass production of the P-40 was that a change-over would reduce output at a time when aircraft were vitally needed by the Russians. While the Committee agrees that this decision was necessary, it "regrets that earlier decisions which concentrated so large a portion of our production on a plane which, although usable, is regarded by the Russian, English and American forces as at best second choice."

Major modifications since introduced on the P-40 are said to produce an aircraft which would compare with the North American P-51 Mustang, "which is regarded aerodynamically as one of the finest, if not the finest, plane of its type in the world." The Mustang is credited with being superior to the Bell Airacobra, or the P-40, and equipped with an Allison engine is a good low-altitude reconnaissance fighter and fighter-bomber; powered with a Rolls-Royce two-stage engine, it is a good medium-altitude fighter.

Perhaps the most interesting facts emerge from the Truman Committee's review of the position of the dive bomber. As previously reported, for tactical reasons the Army decided to reduce its future production while the Navy goes on with the building programme.

It is stated that "the Douglas SBD Dauntless has to date been the only dive bomber which has been successfully used in large quantities by the Navy." The improved version, the SB2D, is expected by the Navy to have an excellent performance. Despite this, the Committee finds that large contracts were placed with Curtiss-Wright for an experimental type, the SB2C Helldiver. A new plant, costing $27,000,000, was built for Curtiss-Wright for that purpose. Large numbers of this type were also to be produced by the Fairchild Engine and Airplane Corp. and Canadian Car and Foundry, and an Army version of the dive bomber (A-25) was to be built at the Curtiss plant at St. Louis.

"Production of such dive bombers was to have been commenced by Curtiss-Wright in December, 1941. It did not actually commence until September, 1942. It has been hopelessly behind schedule and, to date, Curtiss-Wright has not succeeded in producing a single SB2C which the Navy considers to be usable as a combat airplane."

It is stated, however, that in the opinion of the Navy difficulties will be overcome within two or three months. Because, as stated by Curtiss, there was no suitable turret available in the country and the Emerson Electric Co., which originally

DEMOCRATIC DOCUMENT

had to produce it, could not take up additional work, a new turret was designed for the Helldiver by Curtiss, which both the Committee and the Navy found unsatisfactory.

In summing up the dive-bomber chapter the report says that the loss involved in these matters cannot be ascertained, although they seem to run into well over $100,000,000. "One of the most important losses is due to the psychological effect upon the workmen in the plant. In the main they have little to do and many have suspected that the war effort was being sabotaged because they did not realise that the inactivity was due to the inability of the company to produce a satisfactory plane and to obtain sufficient working personnel."

Setting these allegations aside, the present position of the dive bomber appears to be as follows: The production for the Army of the Helldiver and the Vultee A-35 (Vengeance) will be considerably reduced. The Navy's dive-bomber programme calls for the production of many thousands of aircraft, a figure which is justified by including heavy allowances for attrition and training. The Committee believes that the Navy should re-examine its dive-bomber programme and make certain that it is not greater than that justified by the Navy's own interpretation of its technical value. Of the individual types, even allowing for improvements in the Helldiver production, the improved version of the well-proved Dauntless is likely to remain the mainstay of the Navy's equipment. A limited production of the Brewster SB2A, by the Brewster Aeronautical Corporation, which has been taken over by Henry J. Kaiser, will continue only to allow for an orderly transfer to the production of the Brewster F-3A, a version of the Vought-Sikorsky F4U fighter, substantial numbers of which are expected.

Flying Boats

On the subject of flying boats, tremendous numbers of which have been contracted, the Committee hold that their functions are extremely limited because of their slowness and vulnerability. The view is upheld by the Navy, which would prefer for many uses land-based aircraft, and is prepared to cut down production of flying boats to the extent that it can obtain such land-based types.

Criticism is also levelled at the Navy's predilection for unusually high strength factors, even at the expense of performance, which require flying boats to be able to alight in a choppy sea with four- to five-foot waves, involving a large number of bulkheads, cutting up space and impairing the boat's cargo space usefulness. While this consideration for an all-round employment of flying boats is appreciated, both the Committee and the Navy have agreed that special experimentation with purely cargo non-combatant flying boats with less strength built into the hulls should continue. Incidentally, it is said that "the Mars is relatively worthless because of the bulkheads that have been built into it, and it has not yet been put to any important practical use."

A rather medium course is advocated by the Report in the choppy waters of the seaplane *v.* landplane cargo carrier controversy. With the weight of landplanes exceeding 150,000 gross pounds and the corresponding weight increase of the landing gear, the Committee considers the seaplane of similar weight more efficient provided it is not cut up by a number of bulkheads. Moreover, "since neither the landplane nor the seaplane could survive a forced landing at sea, it would seem unnecessary to penalise the seaplane as a possible cargo carrier by requiring it to meet unusual stresses and strains."

At the same time the Report does not assign to the seaplane a monopoly of future transocean cargo transport, and believes that *the development of the flying wing presents attractive possibilities*, and experiments should be encouraged.

Helicopters

The importance of helicopters for anti-submarine work is acknowledged, and the advantages pointed out of hovering and spotting as against the employment of aircraft operating at high speeds. The Navy is expecting delivery of helicopters which would carry one man with parachute and life-raft and transmitting and receiving wireless. They will be capable of a range of at least 100 miles, an endurance of four hours and be properly equipped for instrument flight.

In conclusion, one should mention the serious allegations made by the Committee against the Wright Aeronautical Corporation and vigorously denied by the company's executives, as previously reported in this journal. These accusations, which have prompted the Department of Justice to announce a forthcoming preliminary enquiry, and possibly a Federal Grand Jury investigation, are based on the Committee's findings that more than 25 per cent. of the engines built at the plant have failed in one or more major parts during a three-hour test run; that engines were sold to the Government which were leaking; that a substantial number of aircraft using this engine had crashes in which engine failures were involved; and that unsafe material had been discovered in completed engines.

Stating that the company was producing and causing the Government to accept faulty material, the Committee levels the following major charges against the Wright Corporation: (1) Falsification of tests. (2) Destruction of records. (3) Improperly recording test results. (4) Forging of inspection records. (5) Failure to segregate substantial material. (6) Failure to destroy promptly or mutiliate such material. (7) Orally changing tolerances allowed on parts. (8) Skipping of inspection operations, to which it is added that the Committee found "that in this particular case certain Air Force officials exhibited an unduly co-operative spirit towards the company in matters pertaining to inspection."

Pending further and complete investigations, it would be premature to form an opinion on the implication of these allegations. Whatever one's views on the Committee's criticisms may be, it must be acknowledged that their work is a substantial contribution to the American war effort.

Ruthlessly attempting to get to the core of the problems, the Committee's unhesitating and public disclosure of weak spots and deficiencies is unimaginable in any Fascist country. The frankness of the Truman Report makes it a document eloquent of the bold spirit of American democracy.

POST-WAR AIRCRAFT TYPES

Captain Bartlett Prognosticates

ADDRESSING the Bristol Chamber of Commerce the other day, Capt. K. J. G. Bartlett, a director of the Bristol Aeroplane Co., Ltd., outlined briefly the five or six different types of aircraft which might be expected to suit traffic and geographical conditions in British post-war aviation.

For the direct transatlantic traffic he foresaw a multi-engined landplane with luxurious accommodation and capable of non-stop still-air flights of 5,000 miles. He thought the flying boat had psychological advantages, but the reliability of modern aircraft engines should make forced landings unlikely. The transatlantic types would hold positions in the air similar to those held by such ships as the *Queen Mary* and *Queen Elizabeth* on the sea. The main transatlantic types might be supplemented by a smaller type, similar to those used on the Empire routes. This would probably fly via Newfoundland and Iceland.

For the Empire and main trunk lines Capt. Bartlett visualised four-engined aircraft with a range of 2,000 miles and carrying day and night accommodation for about thirty passengers. The same type of aircraft, but with day accommodation for fifty passengers, would provide a suitable tourist-class companion to the main-line type. Both would also be suitable for the South American route and for a route to China via Russia. Cruising speed should be 200 m.p.h., nearer 250 m.p.h. if possible.

For the European routes and as main feeder-line types on the trunk routes a twin-engined machine with a range of about 500 miles and carrying 20 to 30 passengers would be suitable. It would have to be very fully equipped for all-weather flying.

Great Britain would need small economical 10-16-passenger machines. These could also serve as secondary feeder-line types on the trunk routes.

The last two types dealt with by Capt. Bartlett were specialised machines. One was a mailplane, which would probably be a high-speed, high-altitude type. The other was a freighter, which would be of relatively low speed and would be designed for taking a large volume of freight rather than a large weight.

Behind the Lines

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

For Safety

WITHIN a competition organised by the Italian Air Registration Board, Major Gaspare Santangelo, of the Technical Branch of the *Regia*, has submitted a paper on a "Device to prevent the loss of lateral stability in aircraft."

The project is said to provide for the mounting of two Krell pressure plates to the outer wing panels, which, when critical angles of incidence are attained, would not only warn the pilot but also deflect additional elevator surfaces on the elevator unit, either hydraulically or electrically; these would tend to reduce the angle of incidence and would prevent a loss of stability even with the control column pulled right back.

Charcoal

ON account of the acute fuel shortage the Vichy Inter-Ministerial Economic Committee resolved in July, 1941, to build about 100 factories for the production of charcoal. The total annual output of the proposed plants was estimated at 200,000 metric tons and the plan provided for an even distribution of the plants throughout the country to reduce costs of transportation.

It is now reported that 65 factories have been constructed and equipped, and the present production of charcoal fuel for generators is estimated at 10,000 tons monthly.

Fog

COMMENTING on the raid carried out by American aircraft on Trondheim on July 25th, a German report states that immediately the alert was sounded an artificial fog was spread over the town. This, it is said, forced the raiding aircraft up to a height of 22,000 to 26,000ft.

It appears, however, that this form of defence cuts both ways, for the report comments that it handicapped the work of A.A. artillery and the defence had to rely mainly on fighters.

Dyak Chieftain

ACCORDING to a German report, Greek fishermen in the Aegean Sea rescued an R.A.F. officer on July 23rd who had crashed in his damaged bomber. His name is given as "Major Macpherson," and it is said that his papers included a document signed by a Colonel of the 8th U.S.A.A.F. and describing him as a "Dyak Chief" and the most successful Aegean pilot of the R.A.F. in North Africa.

The "document," which seems to be incomprehensible to the German sense of humour, was apparently presented to Macpherson on his "promotion to the rank of Chief of the Dyaks," and is said to contain the following passage: "With the help of his sipeds he won many trophies over the Aegean Sea. He thus added greatly to the emblems of victory on the roof beam of our poor hut."

Incidentally, the Dyaks are a tribe of head-hunters in Borneo who use sipeds, or blow-pipes, to shoot arrows at their enemies.

EXIT: Rino Corso Fougier, Mussolini's air expert.

Conference

Luftwaffe Field Marshal Kesselring, and the German Minister to Rome, von Mackensen, conferred with Badoglio on July 26th to discuss the future. It will be remembered that Kesselring is (or perhaps, by now, was) the Chief of *Luftwaffe* units in Southern Italy.

The Northern Route

REVIEWING German efforts to cut Northern supply routes to Murmansk and through the Barents Sea, the Russian journal *Red Fleet* states that the *Luftwaffe* employs in these operations Heinkel He 113s on floats as torpedo-bombers, and the Heinkel He 111 and Ju 88 specially adapted for torpedo carrying.

For reconnaissance work the Do 18 and B.V.222 are being used; the latter is said to be equipped with extra fuel tanks in place of 26 of the passenger seats of the aircraft.

The Russian report says that in these operations reconnaissance aircraft endeavour to locate convoys and to bring torpedo aircraft on the target by means of their powerful wireless installations which act as radio beams.

Musca Domestica

THE house-fly has always fascinated airmen with its flying technique. A Paris scientist is now reported to have discovered the existence of a minute organ, "the balancer," under the fly's wings. This organ, in the opinion of the scientist, enables the insect to keep its balance in flight; when it is removed the fly can still fly but is not so steady and can be caught without difficulty. A new "Fly-catching without tears" is not the object of these observations, for it is believed that since other two-winged creatures possess the same mysterious organ, the problem will now be studied in the interests of aviation.

Regia's Man

A REPORT from Rome says that Mussolini's friend and favourite, *Generale d'Armata Aerea*, Rino Corso Fougier, has been relieved of his post as Under-Secretary of State for Air. Fougier commanded the Italian Air Corps which operated for a very short spell with the *Luftwaffe* over the Channel and against this country, and he was subsequently appointed Chief of Staff and C.-in-C. of the *Regia*. The report does not state whether he retains his service command.

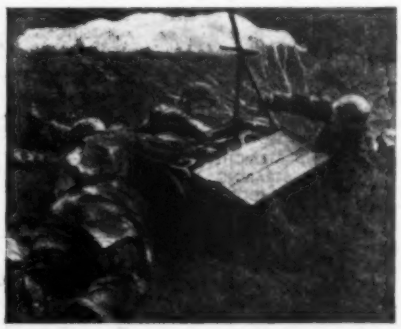
It will be recalled that the portfolio of the Air Minister was held by Mussolini with the Under-Secretary for Air as his assistant. As yet it is not clear whether Badoglio retains the portfolio or whether the two jobs were now united; Fougier's successor in the Air Ministry is Air Brigadier Gen. Renato Sandalli.

From Norway

A PRIVATE report says that the Herøya Aluminium Factory near Porsgrunn is controlled by the German industrial concern *Nordag*. The famous I.G. Company is also co-operating and the production of light metal for the German aircraft industry was scheduled to start this summer.

In Trondheim workshops and concrete shelters have been built for submarines.

It is also said that although considerable numbers of aircraft were removed from Norway to the Russian front, the three Trondheim airfields, Orlandet, Vaernes, and Bulandet still retain substantial fighter strength.



AERIAL BACTERIOLOGY: The *Luftwaffe* now employs paratroops for testing water supplies in the advance zones of the Russian front. (Above) the parachute has just landed and light arms are being unloaded. Picture on the left shows an open container.

Sixtieth of the Latest Recognition Series

Aircraft Types and

FIAT B.R.20

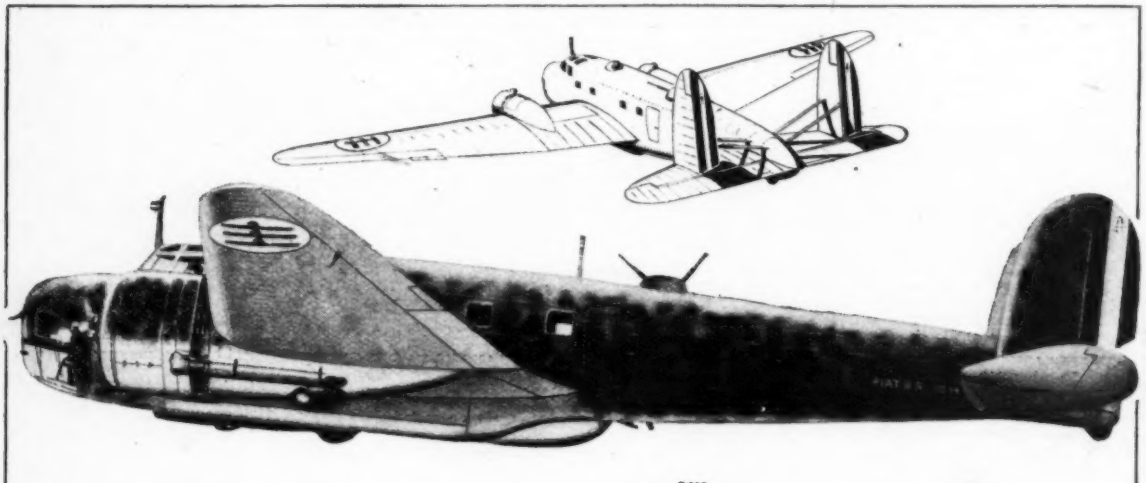
APPROXIMATELY in the same weight class as our own Wellington, the Fiat B.R.20 can claim two distinctive characteristics among the bombers of the *Regia Aeronautica*; it follows the twin-engined formula instead of the three-engined layout more usually favoured by Italian designers, and it was the type chosen to operate against London when Mussolini asked Hitler to allow him to share in the honour of bombing Britain's capital.

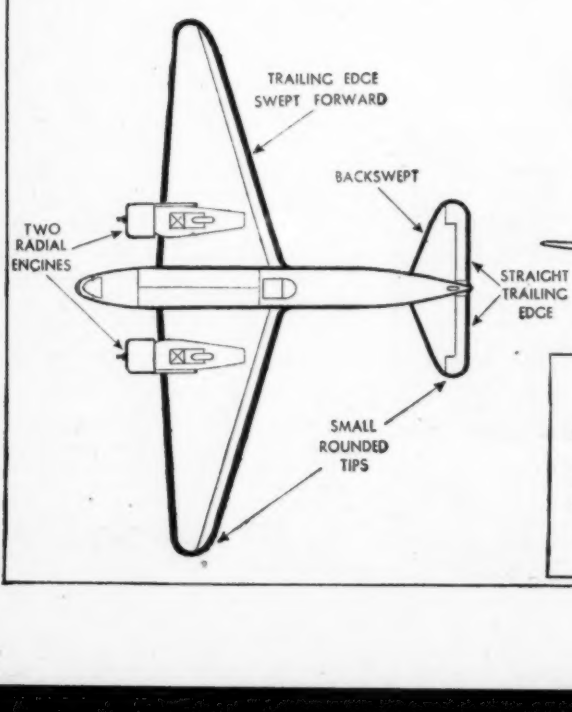
Possibly it was chosen for this job *because* it was a twin-engined, mid-wing design, with some idea that it would not be so easily identifiable as a typically Italian three-engined type when it appeared in daylight over our shores. If so, that was just another of Mussolini's little blunders, for it will be remembered that very few of the B.R.20 bombers which left their Belgian bases ever returned to them; most of them "had the honour" of being shot down into the English Channel by Spitfire and Hurricane pilots who had not the slightest difficulty in either identifying or disposing of them.

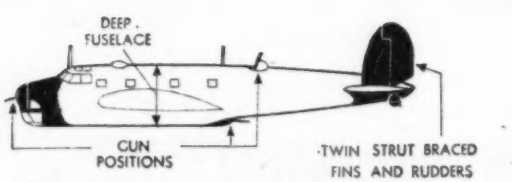
Possibly the most characteristically Italian part of the B.R.20 is its twin tail, with its rounded fins and rudders set above the tailplane well in from the tips and strut-braced to the fuselage.

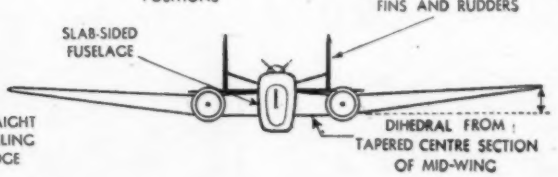
Powered by a pair of 1,000 h.p. Fiat A.80 R.C.41 18-cylinder double-row, air-cooled radial engines, it has a top speed of 264 m.p.h. at 13,000ft., a service ceiling of 26,000ft., and a range of 1,240 miles at a cruising speed of 210 m.p.h.

Whilst the framework of wings and fuselage are all-metal, a composite form of construction is employed. The fuselage employs the stressed-skin monocoque principle in the front portion, but the tail portion is built up of steel tubing covered by fabric. The wings, which have two main spars, are metal-covered along the leading-edge, but the trailing portion has a fabric covering over tubular ribs. Armament consists of a rifle-calibre machine gun in the nose and at the rear of the bomb bay, and two machine guns in a retractable dorsal turret. Bomb load is 3,500 lb.







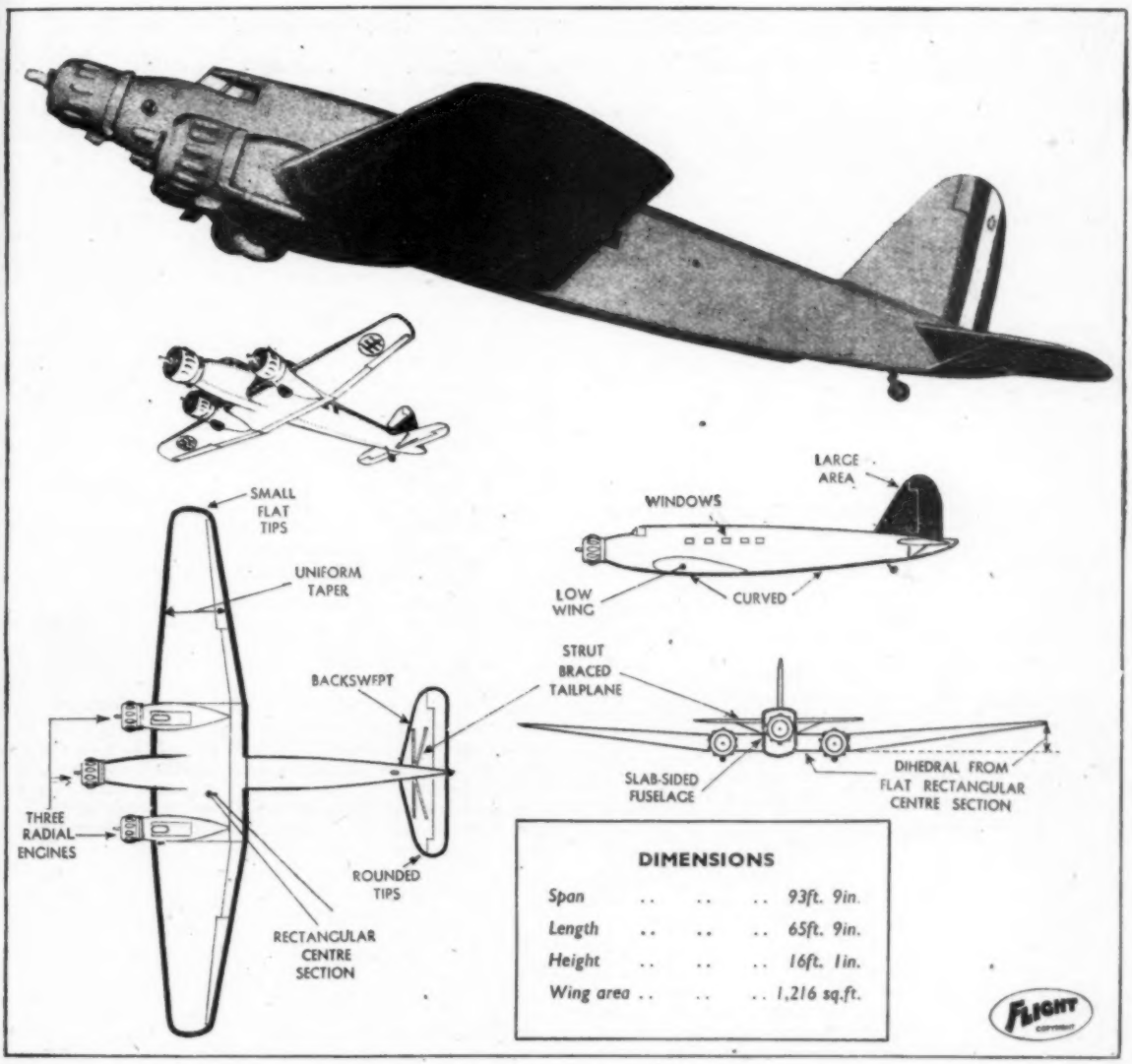


DIMENSIONS

Span	*70ft. 9in*
Length	*52ft. 9in*
Height	*14ft. 1in*
Wing area	*800 sq. ft*

...heir Characteristics

FIAT G.12



DIMENSIONS

Span	*93ft. 9in.*
Length	*65ft. 9in.*
Height	*16ft. 1in.*
Wing area	*1,216 sq.ft.*

DESIGNED originally as a commercial airliner to carry a crew of four and 14 passengers, the Fiat G.12 has been used by the *Regia Aeronautica* as a military transport, though not in any great numbers. Presumably this is because not a great many had been built before Mussolini "muscled in" (in true gangster style) on Hitler's war racket, and the Fiat concern was thereafter fully occupied in producing fighters, bombers and engines for their own and other Italian aircraft.

It is therefore one of the less well-known Italian transport aircraft, but, as will be seen by the dimensions given above, it is also one of the biggest. How many of the type are still in service it is, of course, impossible to say, but it can obviously be taken for granted that, in view of the marked decline in the strength of the *Regia Aeronautica*, coupled with the hampering effects of R.A.F. visits to Turin and other centres of Italian war industry, the misguided Wops must be compelled to keep in service anything that can still be made to fly tolerably well.

The Fiat G.12 (the G stands for the name of its designer, Gabrielli) conforms to the usual Italian preference for three engines, by which a reasonably good performance is obtained with comparatively small power units. In a transport type this arrangement does not incur the same handicap as in the case of a bomber, in which the nose of the fuselage is the ideal position for the bomb-aimer, but it does impair the aircraft's aerodynamical qualities, which is rather important if speed is a desirable feature.

Powered by three 770 h.p. Fiat A.74 R.C.42 14-cylinder, double-row, air-cooled radial engines, the G.12 has a top speed of 236 m.p.h. at 15,744ft., a service ceiling of 26,240ft., and a range of 1,080 miles at a cruising speed of 186 m.p.h., and its gross weight of 27,500 lb. allows for a useful load of 8,404 lb. It is of all-metal construction, the fuselage being a duralumin monocoque structure and the wings having a rectangular centre-section of steel lattice-work and tapered outer panels in box-section duralumin.

Topics of the Day

In Support of Standardisation

"Indicator" Returns to a Time-honoured Subject : The Need for Similarity in Certain Controls : Must it Always be a Case of Every Designer for Himself? : Convenience versus Expediency

ADMITTEDLY I've talked about the need for control standardisation at least once before, but, at the risk of being boringly repetitive, I want to offer some more comments and arguments. The point is, I feel, a very important one, and quite a few expensive, if "safe," accidents could have been prevented if anyone of influence had taken the matter up long ago.

The basic trouble is that the different manufacturers and designers carry on very largely in their own sweet way, and are rarely much influenced by other people's ideas or arrangements. Furthermore, test teams—or, at least, the senior and more important members of the test teams—remain unchanged year by year and have their own fixed ideas, bred of familiarity, of what constitutes an ideal lay-out. I know very well that if these teams moved regularly from factory to factory the troubles would be cleared up in a month, since a test pilot's opinions carry more real weight than those of anybody inside or outside a factory. Otherwise, any move must obviously come from the top and take the form almost of an order, or a basic feature in all specifications.

With aircraft and ancillary design or layout in such a necessarily fluid state, it would be impossible to lay down hard-and-fast rules about the disposition of the different controls. So much depends on convenience of installation. But certain broad ideals might be aimed at, and shapes, at least, might remain constant.

For instance, though I have a personal preference for an undercarriage selector lever which can be reached easily by the throttle hand (so that one's right hand can remain continuously on the control column during the difficult period of initial climb), I am by no means adamant about it, and there are certain advantages, particularly with high-efficiency twins in having the selector on the right side so that the hand can be kept on or near the throttles. Engines *do* stop and throttles occasionally vibrate back and cause a swing in one direction or the other. But I can see no reason at all why the lever shouldn't always be the same shape, have the same relative movement and, most important of all, have the same kind of safety device.

Standard Knobs

Even if no other control is considered, I think that the undercarriage selector should be standardised just as soon as possible. All selectors should be the same length, relative to surrounding objects, should be the same colour, should have the same shape (this is important, because one normally feels for the little beast), and should have exactly the same kind of locking and/or safety device. All of us, at one time or another, have fought for a matter of twenty vital seconds with a strange kind of safety catch which couldn't be made to work and which, of course, couldn't be tested and tried before actually becoming airborne. Some of them involve the most intricate work with the fingers; once, in the old days, I met one which couldn't be moved at all, and I had to land, find another example of the same type on trestles, and practise with the darn thing until I found out how to release the catch *and* operate the lever with one hand and one hand only.

While on the subject of hydraulics, I'm not at all clear why certain aircraft types still suffer from that old-fashioned device, the "power bolt" or master hydraulic control. It has certain technical advantages, of course, but it seems to me to be an anachronism in 1943 and merely adds to the mental and physical labours of the unfortunate pilot. The flap lever is not important, but it should have a very distinctive shape so that it will not be confused with the undercarriage lever, and be near, but not too near, the latter.

I see no reason, either, why flap and undercarriage indicators should be as various as peacetime spring models, and in such totally different relative positions. The former vary from invisible mechanical pips, which move up a thing like a slide-rule, to little clock faces showing a highly inaccurate series of degrees or percentages. Undercarriage indicator design varies from a series of lights to a collection of shutters, rather like the old-fashioned household bell indicators. Even the lights don't necessarily indicate the same things. Some of them show nothing whatever when the undercarriage is properly home, and others glare unblinkingly at you for the rest of the flight; some can be switched off and others are always on. Every one of the myriad ingenious devices has something or other to recommend it, and nobody can blame each manufacturer for sticking to his well-proved and favourite system; but surely somebody can say quite firmly that they shall all be this kind or that kind, for better or worse?

Universal Brake Lever

Except for the basic differences between American and British ideas of brake operation, here, at least, we are in a very nearly perfect position. Two or three aircraft of an obsolescent or partially obsolescent nature have ordinary car-type brake levers which, when negotiating difficult corners, involve the pilot in hysterical contortions between the throttles and the lever, but the control-column thumb-lever is pretty well universal over here and, with one or two exceptions, the pedal-type brakes, with their dashboard locking device, are universal in America. Each has its points and nobody minds good basic differences of this kind—except the unfortunate pilots who are expected to fly each more or less alternately.

Throttles and airscrew controls needn't be together, but they should be near to one another and move in the same direction. Here, too, undue similarity in feel should be avoided as far as possible. In some American types the pilot has almost to read the notices before he dares to move any lever in the quadrant in case he takes a handful of airscrews when throttling back, or a handful of carburettor heaters when he intends to reduce the revolutions or put the automatic pilot into action.

The most dreadful errors in cockpit layout design are those of arranging the throttles so that either the small pilot cannot open them fully or he catches his knuckles on assorted items as he opens up; and those of placing the pitch controls in such a position that the pilot has to lean forward and downward when he is reducing revolutions after take-off. I know of two types in which the pilot actually loses sight of the ground and sky ahead during this operation. Once I very nearly wrote myself off in a strange type through this cause; I had to lean right down to reach the c.s. controls, and had not been told that this particular machine became progressively nose-heavy as the undercarriage went up. When I'd finished the job of bringing back a "runaway" engine (the c.s. control stop had been incorrectly adjusted) I found that the machine had been losing height at the same trim setting and we were about to charge into a row of elm trees.

In brief, one should be able to carry out every one of the operations which are done immediately after take-off without excessive movement and without taking one's eyes off

IN SUPPORT OF STANDARDISATION

the landscape ahead. And there is no excuse for an aircraft in which this yardstick does not apply—excepting, perhaps, some of the really big stuff in which a flight engineer is there to do the odd jobs.

Quite surprisingly good and modern examples are sometimes spoilt by just one little thing. For instance, in a particular version of one type, the undercarriage selector is on the right and the control column is of the plain stick type; the selector cannot quite be moved with the left hand, and a change-over involves letting go of the column for a brief second or so each way. Now if that stick had even been of the "spade grip" kind the criticism would hardly apply, while the layout was probably designed in the first place for use with "spectacles." If a hand change-over is necessary it should be possible to make it without difficulty or inconvenience—and a modern aircraft is not under very good control at the moment when the undercarriage is raised after take-off.

As for trimming gear I can see no good reason why all such controls should not be conveniently placed and arranged to work in an axially natural manner. This applies particularly to the rudder tab control. On some obsolescent types this was singularly bad, and was actuated by a wheel or crank handle working in a fore-and-aft, or even a lateral axis; every time it was used the pilot had to think it out or just try and hope for the best. Even some very modern aircraft are by no means blameless.

Such items as petrol cocks and engine cut-outs are not of great importance, but the pilot likes to be able to see and reach the former and to be able to work the latter without giving himself a form of muscular cramp. And *all* taps should have some kind of stop before the "off" position. I don't like to remember how many times I've momentarily turned the fuel off when changing or testing tanks, just because the control (wheel or tap) moved in each direction and had no positive stop. In one or two older types the individual tank cocks were way down the fuselage; occasionally, when flying alone, the tanks would begin to empty in an odd way and there was nothing one could do about it. Once, at least, in my experience, a chap was instructed to go aft and change over from X to Y tanks; all that happened was a pained and protracted silence from both motors after a minute or two's flying. Luckily, the chap in question was not one to flap, and the vital urge duly returned after half a minute.

As a final shot, even control column shapes should be standardised. With a really good example, the pilot flying a machine for the first time should not be able to *remember* the shape. It should be as natural and usual as that.

"INDICATOR."

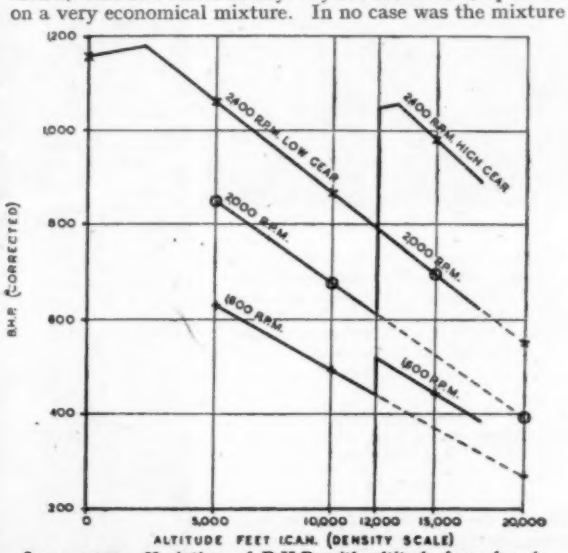
Type-Testing the Jumo 211D

Take-off Power 1,160 B.H.P. at 2,400 R.P.M. and 4.7 lb./sq. in. Boost

THE Ministry of Aircraft Production has had bench tests made of the Junkers Jumo 211 fuel-injection aircraft engine. Following is the official report on the tests:—

Summary.—Jumo 211D engines from Heinkel aircraft were subjected to brief bench tests to determine b.h.p. output, fuel and air consumption rates, and general handling qualities using 92 octane fuel and D.T.D. 109 oil. Maximum power was 1,160 at 2,400 r.p.m. and 4.7 lb/sq. in. boost pressure for take-off at sea level, and 1,080 b.h.p. at 2,400 r.p.m. and 4.7 lb./sq. in. boost pressure at 12,000ft. I.C.A.N. altitude (see attached curve).

The engines, which, apart from sparking plug adjustments, were not tuned in any way for these tests, operated on a very economical mixture. In no case was the mixture found to be outside the range 96 per cent. to 123 per cent. of "correct" for a wide range of throttle settings, boost pressures and speed. At "take-off" the mixture strength of the starboard engine was 101 per cent. of correct, and corresponding fuel consumption 0.46 lb./b.h.p./hr. Opening-up was excellent with no flat spots, while acceleration was at least as good as for carburettor engines. The engines ran smoothly down to 195 r.p.m. Use of the supercharger high-speed gear was automatically prevented at heights below about 12,000ft. by a capsule control.



Jumo 211D. Variation of B.H.P. with altitude from bench tests. Fuel 92 octane.

Report.—The engines tested were of the 12-cylinder inverted-V, liquid cooled type, 150 mm. bore, 165 mm. stroke, compression ratio 6.5 to 1 of generally similar design to the 211A engine, but differing in details. Apart from attention to the sparking plugs no engine adjustments were made, although the crankcase covers were removed for a casual internal inspection before running.

Fuel and Oil.—Fuel of approximately 92 octane No. (C.F.R.) and D.T.D. 109 oil were used.

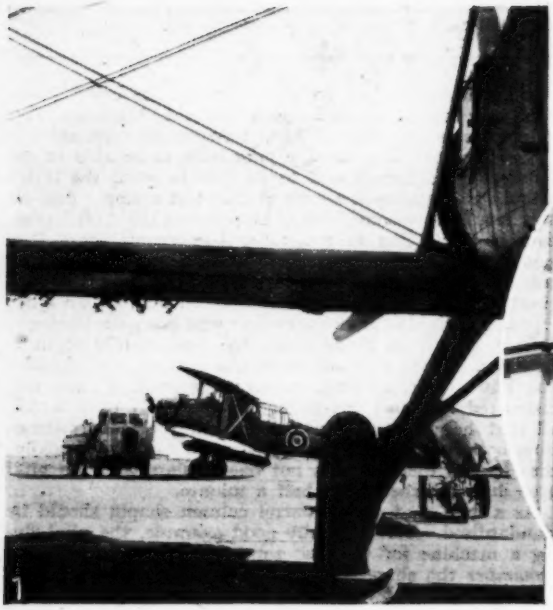
Performance at Altitude.—Fig. 1 shows the variation of b.h.p. with altitude at constant rotation speed, with the throttle lever fully forward, as found by crossplotting the altitude power curves. It was found that the capsule controlled servo unit permitted use of the high-speed supercharger gear at heights above approximately 12,000ft. At this height the boost pressure at 2,400 r.p.m. would be 4.7 lb./sq. in. or the same as the controlled boost at take-off.

A wind speed of approximately 70 m.p.h. was directed into the forward facing intake pipe. The full output of the engine was therefore observed. Take-off boost 4.7 lb./sq. in. at 2,400 r.p.m. was a controlled boost as the supercharger delivery pressure at ground level was 6.2 lb/sq. in.

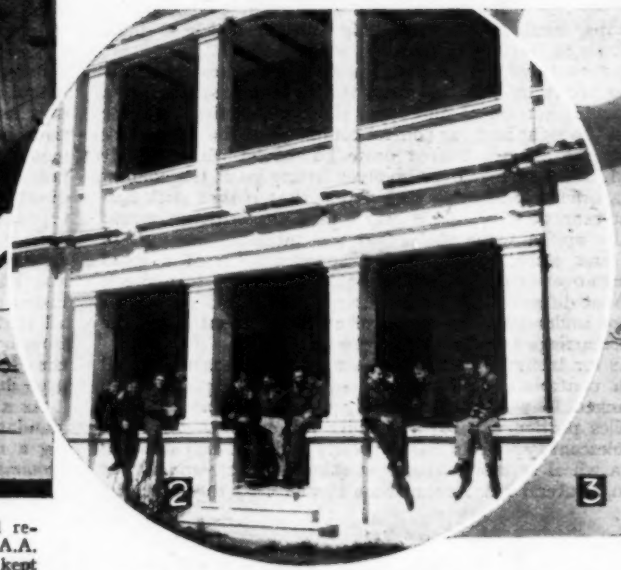
General Handling Qualities.—All engines handled extremely well. Opening up was very good with no flat spots, and response to changes of the throttle setting was immediate. Acceleration was at least as good as for carburettor engines.

The boost control gave no trouble and the supercharger change-gear unit worked satisfactorily, taking about one second to operate.

Albacore i



1. Refuelled and re-armed. The F.A.A. Albacores are kept ready for immediate attack in case of emergency.

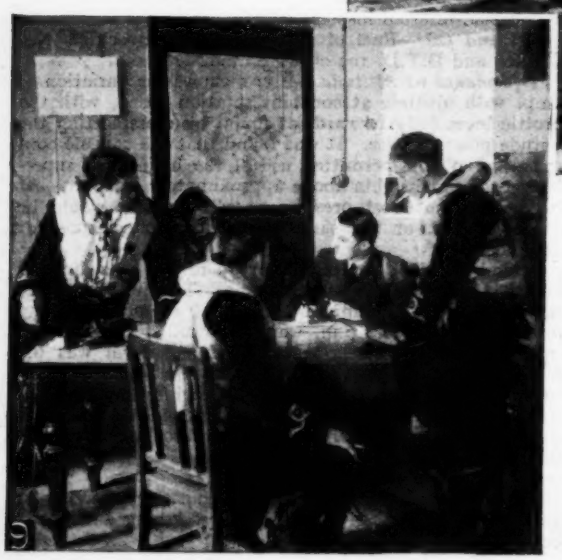


2. Officers' messes are in permanent buildings taken over by the the authorities for the duration of the war.

3. The Fleet Air Arm gremlin who welcomes visitors to the mess bar.

Fleet Air Arm Torpedo-dropping Units Which Did so Much to Prevent Axis Supplies from Reaching Their Troops in Africa : Nearly Forty per Cent. of These Supplies Were Destroyed by Sea and Air Attacks

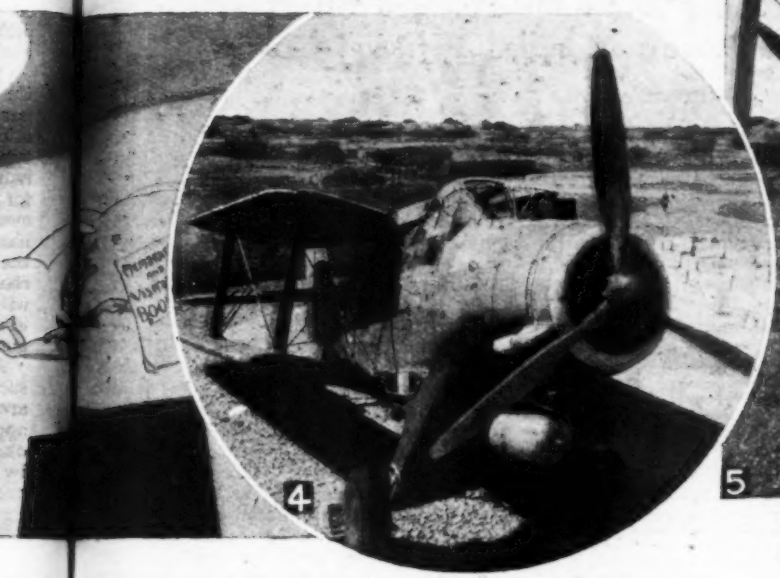
6. Three Fairey Albacores off on a shipping strike. The foreground is typical of Malta—tiny pocket-handkerchief-sized fields with low stone walls. Forced landings almost invariably mean write-offs.



9. An interrogation of an aircrew after their return from an attack on Axis shipping.

10. In the armoury. Only spotless guns, well maintained and cared for, can ensure an absence of jams at critical moments.

...e in Malta



4. An Albacore torpedo-bomber with its wings folded in its blast-bay. The blast-bays are made either of stone blocks from blitzed houses or of empty four-gallon petrol tins filled with earth.

5. An armourer prepares the dual Vickers K machine guns which are carried for the rear protection of the Fairey Albacore.

by the

ess bar.

7. Ship torpedoing is done more by night than by day. Visibility in moonlight over the sea is usually excellent, and even on moonless nights ships are betrayed by their wake if they are travelling at anything over their normal half speed.

8. In the crew room of No. 821 Squadron F.A.A. The wind speeds from sea level to 5,000ft. are recorded on a blackboard.

The Fairey Albacore

2/3 seat torpedo-spotter-reconnaissance biplane. All-metal fuselage. Metal and fabric wings. Span, 50ft. Length, 39ft. 10in. (seaplane 42ft. 5½in.). Height, 14ft. 2in.

Engine: Bristol Taurus II fourteen-cylinder sleeve-valve radial, rated at 860/900 h.p. at 5,000ft. Maximum output 1,065 h.p. at same height.

11. Aircrews are briefed from information brought in by reconnaissance aircraft or air photographs.

Plywood and Plastics—III

Basic Design Factors and Stress Data for Plywood Structures : The Simple Plywood Fuselage : Moulded Plywood Design

By W. NICHOLS, A.R.Ae.S.

THE previous article concluded with an approach to the subject of tangential and radial shrinkage of wood. It was stated that all woods shrink more tangentially (parallel to the growth rings) than radially (perpendicular to the growth rings). It was pointed out that the ideal wood for aircraft purposes would be one in which a low percentage of shrinkage was combined with a low ratio between the amount of shrinkage in either direction, the optimum ratio being 1.0, a condition never found in practice. The ratio for various species is shown in Fig. 10.

From Table 12 it will be seen this ratio varies from 1.28 in yellow birch to 2.16 in beech. In the manufacture of veneers these shrinkage values may be emphasised, depending on the method of cutting. With rotary-cut stock, the broad surface is all tangential wood, and this shrinks a great deal more laterally than in thickness.

In quarter-sliced stock only the radial face is in evidence, and the whole piece is more stable. In flat-sliced stock the predominating flat surface is radial, and this is also more uniform than rotary-cut veneer. It is this fact which accounts for the greater amount of "buckle" in rotary veneers.

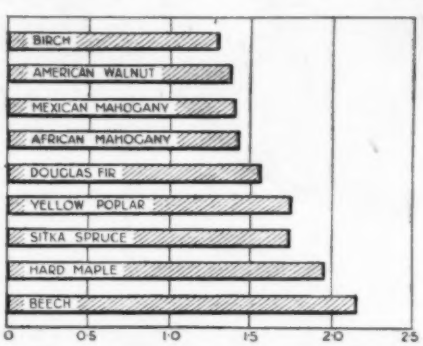


Fig. 10. Ratio of tangential to radial shrinkage of various woods.

Moisture Content

Obviously panels made of rotary-stock woods having a high ratio, as indicated in Table 12, are much more apt to develop internal stresses due to shrinking than are panels made of quartered or sliced stock, particularly on the thin panels commonly used for aircraft purposes.

One of the first and most important characteristics to be understood in connection with wood veneer is the moisture content, a wrong value of which can make an otherwise perfect piece of wood worthless. Wood will always absorb or give out moisture until it is in equilibrium with the humidity of the surrounding atmosphere. At the same time there will be a corresponding change of dimensions. Wood, as already explained, is made up of a substance, mostly cellulose and lignin, expanded by virtue of its cellular structure to a specific gravity usually below that of water. Change of dimensions will occur, due to the absorption of water in this substance, and not in the pores of the wood, which, incidentally, does not cause appreciable swelling. Dense woods, therefore, will swell more than light porous woods, due to the greater amount of wood substance in a given volume of dense wood than light wood, a point to be remembered in air design.

As wood becomes drier, the majority of its strength characteristics are rapidly increased, thus the obvious conclusion is to use exceptionally dry woods and to utilise a protective coating on the surface to maintain this moisture content as low as possible. Experience has shown, however, that the stress or the proportional limit increases at a greater rate than does the modulus of rupture or the modulus of elasticity.

The material appears to lose ductility in a dried-out condition, and there is a limited plastic flow range before failure takes place. A starved glued joint is liable to occur in gluing if the moisture content is too low. Also, if the moisture content of one ply is greater than that of another there will be a tendency for the panel to buckle or warp, because the content of each ply will tend to balance under any humidity conditions of the air. It has been determined that a moisture content of 7 per cent. to 9 per cent. is the most efficient in affording a good bond between the veneers, which are usually kept stored at this content by holding the relative humidity of normal temperatures within a range of approximately 30 per cent. to 40 per cent. at 60 deg. F., as shown on the chart, Fig. 11. In moulded plywood construction, for example, if the moisture content of the veneers is fairly high, a longer period under the application of heat would be needed during the moulding process. This would result in boiling out of moisture from the cellular structure of the wood, with a consequent low ductility and an exceedingly brittle material.

Tensile strength apparently is not affected. It has been shown, in tests made on European woods by Gerngross at the Technical University of Berlin, that the effect of heating to 284 deg. F. for varying periods of time had little

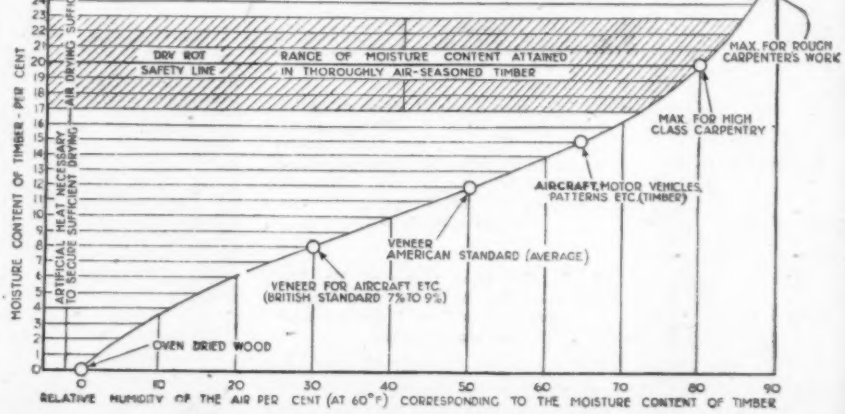

APPRECIABLE SHRINKAGE COMMENCES AT ABOUT THIS POINT
SUITABLE MOISTURE CONTENT FOR PRESSURE TREATMENT (CREOSOTING, FIRE RESISTANCE SOLUTIONS ETC.
DRY ROT SAFETY LINE
RANGE OF MOISTURE CONTENT ATTAINED IN THOROUGHLY AIR-SEASONED TIMBER
MAX. FOR ROUGH CARPENTERS WORK
MAX. FOR HIGH CLASS CARPENTRY
AIRCRAFT, MOTOR VEHICLES, PATTERNS ETC. (TIMBER)
VENEER AMERICAN STANDARD (AVERAGE)
VENEER FOR AIRCRAFT ETC. (BRITISH STANDARD 7% TO 9%)
OVEN DRIED WOOD
AIR DRYING SUFFICIENT
ARTIFICIAL HEAT NECESSARY TO SECURE SUFFICIENT DRYING
MOISTURE CONTENT OF TIMBER - PER CENT
RELATIVE HUMIDITY OF THE AIR PER CENT (AT 60°F) CORRESPONDING TO THE MOISTURE CONTENT OF TIMBER
0
10
20
30
40
50
60
70
80
90

Fig. 11. Range of moisture content, seasoned timber.

PLYWOOD AND PLASTICS—III

TABLE 12
RATIO OF TANGENTIAL TO RADIAL SHRINKAGE OF WELL-KNOWN WOODS

Species	Per cent. Radial Shrinkage	Per cent. Tangential Shrinkage	Ratio
Basswood	6.6	9.3	1.41
Beech	5.1	11.0	2.16
Birch (sweet)	6.5	8.5	1.31
Birch (yellow)	7.2	9.2	1.28
Douglas Fir	5.0	7.8	1.56
African Mahogany ...	4.1	5.8	1.42
Maple (hard)	4.9	9.5	1.94
Spruce (Eastern) ...	3.8	7.8	2.06
Spruce (Sitka)	4.3	7.5	1.75
Poplar (yellow)	4.0	7.1	1.75
Walnut	5.2	7.1	1.36

Based on volume when green and when oven dry.
(From the U.S. Forest Products Laboratory data.)

effect on the tensile strength. From the numerous articles written on the determination of strength characteristics for different moisture contents, reference to the recent work of Mr. G. B. Parsons, chief of stress and structural research, Duramold Aircraft Corporation, U.S.A., will be found of practical value. In this are plotted the strength-moisture content curves for woods commonly used in the aircraft industry. Some examples of these resulting curves for modulus of elasticity, modulus of rupture, and compression parallel to the grain, have been grouped and reproduced in Fig. 12. These graphs are plotted with 12 per cent. moisture content as unity, which appears to be more or less the standard adopted in America. To correct to 12 per cent. moisture any specimen with known moisture content, it is only necessary to divide the value obtained at the known moisture content by the value read from the curve corresponding to the strength characteristic in question.

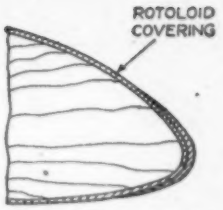


Fig. 13. The cellulose nitrate covering on the Rotol Jablo wood blade.

In moulded plywood construction in which successive veneers are laid with the grains crossing, the bonded surface area is large in relation to the thickness of the veneers, and therefore is better able to cater for any internal strains that may be caused by possible changes in moisture content.

The problem of moisture resistance and dimensional stability is being attacked from two standpoints. The first involves the use of protective coatings on finished surfaces, and will revolve around the development of adequate painting schedules. Upon certain wood airscrews of British manufacture a cellulose nitrate covering is already successfully employed in combination with compressed wood.

The second method involves the impregnation of the veneers, and results in superior and improved moisture characteristics. Almost any degree of resistance may be achieved by this method, but it entails an appreciable increase in cost, and has not for this reason been widely used. This scheme may be accomplished by thoroughly impregnating both sides of all layers of veneers by "dipping" in a suitable resin for a specific period, determined by the veneer thickness.

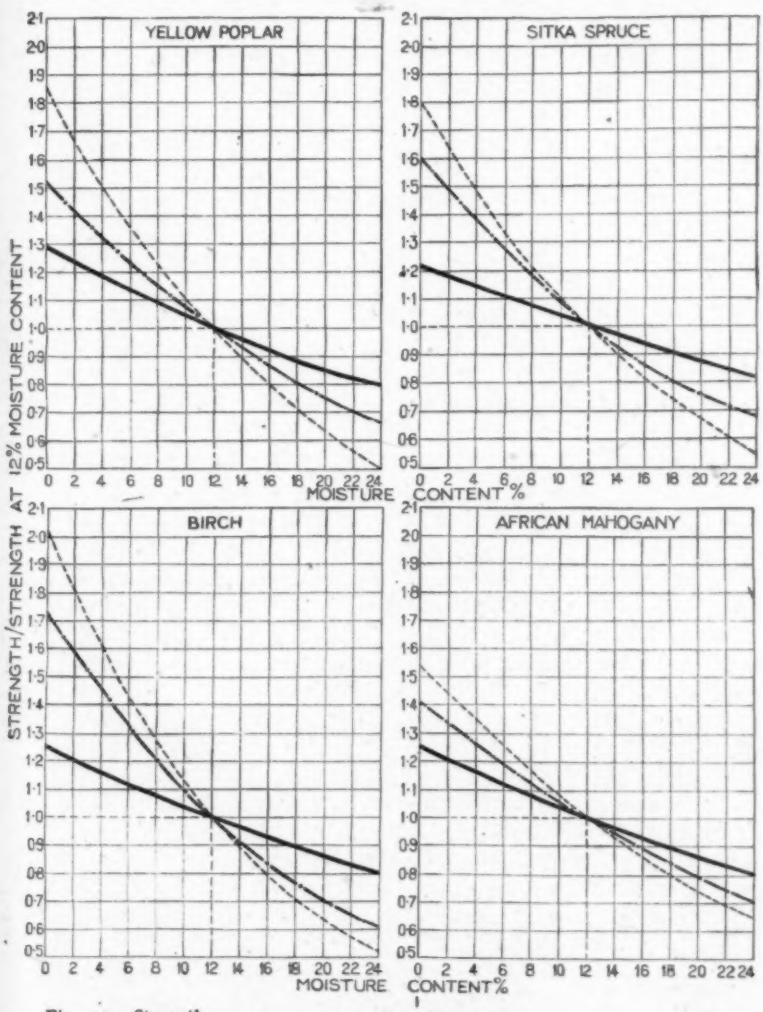


Fig. 12. Strength-moisture content curves for aircraft veneers.

Moisture Resistance and Dimensional Stability

Another method which may be used, and, in fact, must be used where the veneers are $\frac{1}{8}$in. thickness or greater, is to apply the resin to the veneers under vacuum pressure, literally forcing the resin into the wood. Since wood is made up of tiny cells surrounded by porous walls there can be various degrees of penetration which can be predetermined and for all practical purposes controlled.

Complete waterproofness can now be obtained, and seaplane floats have already been produced of impregnated plywood material moulded to shape. The use of this material in the construction of flying boat hulls of the smaller type with complete absence of water soakage (a fault with wooden hulls of the past) now appears to be a practical proposition.

Probably the one variable in plywood manufacture left uncontrolled is that of glue spread. Economically, it is only of secondary importance, but the quantity of glue

PLYWOOD AND PLASTICS—III

applied to unit area can be one of the decisive factors in determining the quality of a glued joint.

Mr. Thomas Perry, an authority upon plywood manufacture in America, has provided this simple rule: The glue spread in pounds per thousand sq. ft. is numerically equal to the weight in grams, plus 10 per cent. of the weight in grams of the glue on the two sides of a square foot of veneer. Thus, by taking a square foot of veneer and obtaining the weight of it in grams, then passing it through the glue spreader and obtaining the weight again in grams, the difference in weight obviously is the weight of glue on the two sides of the veneer. Assuming the difference to be 30 grams, then, according to the Perry rule, glue spread in pounds of a thousand sq. ft. will be 33 lb. (i.e., 30, plus one-tenth of 30), or 3.3 lb. per 100 sq. ft.

Aero-Research, Ltd., have recently prepared a useful chart for converting weight of glue in grams on 2 sq. ft. into glue spread in lb. per 100 sq. ft. This is reproduced in Table 13. Normally, about 3 lb. per 100 sq. ft. is correct for smooth, hard veneers, such as good-quality birch, etc., and in any case it is rarely necessary to exceed 4½ lb. per 100 sq. ft.

So far, the various characteristics of wood veneer and modern adhesives have been dealt with at some length; and, though much of this information may appear to apply mainly from a practical standpoint, it has been deliberately

TABLE 13
TABLE FOR CONVERTING WEIGHT OF GLUE IN GRAMS ON TWO SQUARE FEET INTO GLUE SPREAD IN POUNDS ON A HUNDRED SQUARE FEET

Grams/2 sq. ft.	20	21	22	23	24	25	26
Lb./100 sq. ft.	2.20	2.31	2.42	2.54	2.65	2.76	2.87
Grams/2 sq. ft.	27	28	29	30	31	32	33
Lb./100 sq. ft.	2.98	3.09	3.20	3.31	3.42	3.53	3.64
Grams/2 sq. ft.	34	35	36	37	38	39	40
Lb./100 sq. ft.	3.75	3.86	3.97	4.08	4.19	4.30	4.41
Grams/2 sq. ft.	41	42	43	44	45	46	47
Lb./100 sq. ft.	4.52	4.63	4.74	4.85	4.96	5.07	5.18
Grams/2 sq. ft.	48	49	50	51	52	53	54
Lb./100 sq. ft.	5.29	5.40	5.51	5.62	5.73	5.84	5.95
Grams/2 sq. ft.	55	56	57	58	59	60	61
Lb./100 sq. ft.	6.06	6.17	6.28	6.39	6.50	6.61	6.72

included for the reason that the design of any structure must essentially be based upon a clear understanding of the various characteristics of the material being used.

The simplest use to which plywood can be put in aircraft construction is bracing by flat panels against shear loads, and in this respect it has been used extensively in the fuselage construction of light aircraft, solid timber being used to advantage wherever its properties are superior to those of plywood, such as for longerons, stiffeners, struts, etc. Investigations into a fuselage of this construction were conducted by Aero-Research Ltd., in the past, and results published by them are of interest in leading to the more modern and complicated design problems of moulded plywood construction.

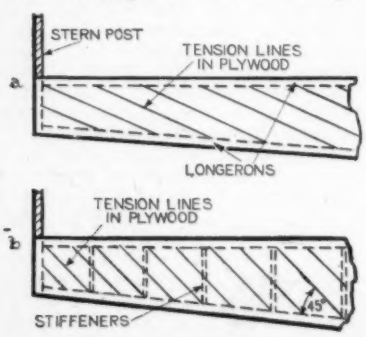


Fig. 14. Tension lines in plywood skin (a) without stiffeners; (b) with stiffeners.

The apparent purpose of the plywood panel to act as a shear resistant web when no stiffeners are present is misleading, due to the considerable depth of the fuselage side and the correspondingly large area of unsupported ply which result in the material being unable to take appreciable compression. Actually in this application the plywood acts similarly to a large number of parallel wires. As these extend under load along one diagonal there is a corresponding contraction along the other diagonal, with the result that the plywood begins to buckle.

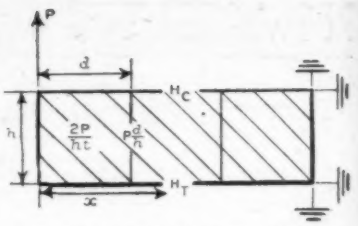


Fig. 15. Stress diagram. Tension lines in plywood show at 45 deg.

Providing the ultimate tensile strength has not been exceeded, this buckling disappears when the load is removed and is not necessarily a sign of imminent failure. Such a structure, however, is weak; the tension in the ply is high, due to the bad angle of the tension lines, and the tendency is for the longerons to be pulled together. With the absence of stiffeners to give support the longeron soon fails in compression through instability; therefore stiffeners become necessary.

As will be seen from the sketch, Fig. 14, the addition of stiffeners results in a great improvement, both in the angle of the tension lines of the ply and the longerons in compression, as the latter are now fairly well supported. The stiffeners are spaced to divide the side of the fuselage into approximately square panels and the tension lines in the ply run from corner to corner at approximately 45 deg. An interesting point is that adding further stiffeners to this spacing does not improve the angle of tension, and so far as the plywood is concerned, nothing is gained by such an increase over that sufficient to divide the surface into square panels.

Determining Size of the Stiffeners

At sections where the bending moment is high, however, the ratio of spacing to fuselage depth must be increased to support the compression longeron against buckling before its ultimate compressive strength is reached. These conditions are realised very simply in practice by maintaining a constant separation between the stiffeners and by reducing the depth of the fuselage towards the tail.

Assuming that there are enough stiffeners to place the tension lines at 45 deg., then from the diagram in Fig. 15, if P be the force applied to one end of the fuselage, the component acting at 45 deg. will be $P\sqrt{2}$, and the cross-sectional area of ply of thickness t cut by the tension lines will be $ht\sqrt{2}$. The tensile stress, in lb./sq. in. will therefore be $f = 2P/ht$. Forces in the compression and tension longerons comprise those due to the bending moment produced by P, and additional forces due to the horizontal component of the tension in the plywood; thus

$$HT = \frac{Px}{h} - \frac{P}{2} \text{ and } H_c = \frac{Px}{-h} - \frac{P}{2}.$$

Tension in the ply increases the force in the compression longeron and reduces the tension in the tension longeron.

The force in each stiffener is the vertical component of the tension in the plywood and is given by $V = P\frac{d}{h}$. To determine the size of the stiffeners it is only necessary to ensure that the stress as given does not exceed about 5,000 lb./sq. in. for spruce. This procedure is safe because it neglects the contribution to the compressive strength from the plywood in the immediate vicinity of the stiffener. Covering the top and bottom of a box fuselage with plywood is recommended.

From tests of loading to destruction it has been shown that longerons can collapse by buckling sideways at a comparatively small load and can be appreciably stabilised by these plywood panels; torsional rigidity is also much increased by this means. A small gap may be left between

PLYWOOD AND PLASTICS—III

stiffeners and longerons without ill-effects. Shear forces in the fuselage side panels are greatest between the wing spars, therefore thicker plywood must be used in this region than suffices elsewhere. As this ply can take compression it should be made to do so by adding stiffeners where test shows them to be advantageous. In this instance the simple analysis given above, in which tension forces only are assumed to be acting in the ply, is no longer valid.

A fuselage of this type supplied by Aero-Research Ltd., was bought by the Air Ministry for investigation, and measurements of the deflections of the fuselage under bending and torsional loads were obtained. Notes from these investigations will be now dealt with, the overall dimensions of the rear portion submitted to test being illustrated in Fig. 16. If such a fuselage is regarded purely as a plywood tube, the torsional deflection in radians can be calculated from Bredt's or Batho's formula:

$$\theta = \frac{Tl}{4A^2G}\int\frac{dp}{t}$$

where T = torque
dp = element of perimeter
l = length of tube
A = area enclosed by tube
G = rigidity modulus of material.

In the graph Fig. 17 is shown the torsional twist in degrees under a torque of 10,000 lb.-in., applied at the stern post, assuming the value of G for plywood to be 1.53×10^5. The experimentally determined points are shown, and it will be seen that except at the extreme end the agreement is good.

It is stated that in a fuselage of this type the skin buckles under load, and is subjected only to diagonal tension stress; the skin has no rigidity against shearing stresses. In these circumstances the conception of a rigidity constant becomes meaningless, and G must be replaced by some other modulus. Consequently the use of Bredt's formula in the above form is open to objection.

The deflection of a shear resistant panel is given by

$$\partial s = \frac{Pl}{Gth}$$

where P = applied load
l = length of panel
h = depth of panel
t = thickness of panel

The deflection of a panel under diagonal tension is

$$\partial t = \frac{4Pl}{Eth}$$

where E = Young's modulus along the tension lines.

Therefore in the derivation of Bredt's formula ∂t is substituted for ∂s giving the modified equation

$$\theta = \frac{Tl}{A^2E}\frac{dp}{t}$$

From this it will be seen that when the tube is so thin that it is in a state of diagonal tension G must be replaced by E/4. The value of Young's modulus for birch plywood with Bakelite adhesive at 45 deg. to the grain is about $.5 \times 10^6$ lb./sq. in. The value of E/4 should, therefore, be 1.25×10^5 which, in view of the difficulties in obtaining consistent results in measuring the deflections, may be said to be in good agreement with the value 1.53×10^5 used previously.

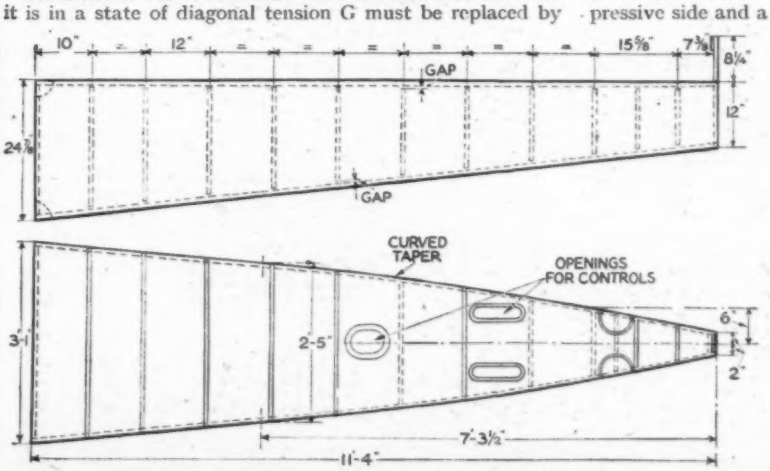


Fig. 16. Overall dimensions of the rear fuselage submitted to test.

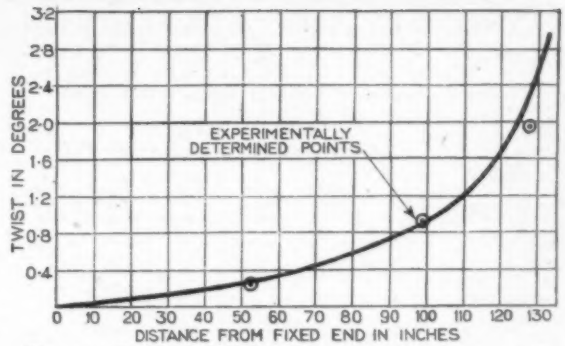


Fig. 17. Torsional twist in degrees under torque load applied at sternpost.

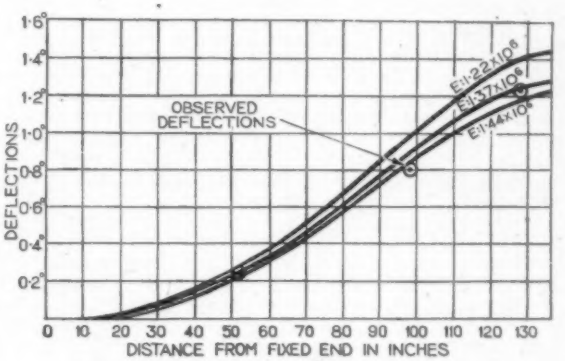


Fig. 18. Deflections of the fuselage under test.

Curves are also shown in Fig. 18 for the computed deflections of the fuselage under an up-load of 1,000 lb. at the stern post, using three different values of E and assuming that the deflection is due to pure bending and is resisted by four longerons only, without assistance from the skin. The three values of E correspond to the mean and two extreme values for the spruce used. The observed deflections are also shown and are rather below the computed curves, due to the fact that a small portion of the plywood on the compressive side and a larger portion on the tension side does assist the longerons to resist bending.

Moulded Plywood Construction

Having briefly dealt with these aspects for the most simple type of fuselage incorporating plywood construction, the recent development of moulded plywood construction will be considered.

One of the first things an engineer must know about any material is the modulus of elasticity. In this respect wood is a little more difficult than other materials since each species has a different value parallel and perpendicular to the direction of the grain. To calculate the modulus of elasticity for any construction of plies and species, Gassner, in the *Journal of the Aeronautical Sciences*, March, 1942, offers a means of working backwards from test data on three-ply panels to

PLYWOOD AND PLASTICS—III

TABLE 14
BASIC STRENGTHS OF AIRCRAFT WOODS 12 PER CENT. MOISTURE CONTENT

Species	Parallel to Grain			Perpendicular to Grain		
	Mod. of Elast. 1,000 lb./sq. in.	Tension Stress lb./sq. in.	Comp. Stress lb./sq. in.	Mod. of Elast. 1,000 lb./sq. in.	Tension Stress lb./sq. in.	Comp. Stress lb./sq. in.
Birch	2,180	16,600	8,170	106.5	810	399
Spruce	1,367	10,200	5,610	51.4	384	211
Red Gum ...	1,535	11,900	5,800	56.9	442	215
Basswood ...	1,160	8,700	4,730	36.8	276	150
Yellow Poplar ...	1,511	9,200	5,290	54.6	333	191
African Mahogany	1,335	10,700	5,670	101.6	855	432

determine from these the apparent modulus of the single veneer.

Space available forbids the inclusion of this lengthy analysis, but values obtained have been grouped in *Table 14 corrected for 12 per cent. moisture content. These values may be checked for accuracy from values obtained from multi-ply panels. Having the modulus of elasticity of each veneer in a composite panel the determination of the apparent modulus for bending characteristics can readily be made, but care must be exercised in choosing the correct modulus for the loading applied.

Panel Subjected to Axial Load

Consider for simplicity a three-ply panel compressed of the same species of veneers subjected to an axial load; the strain in the panel must necessarily equal the strain in each component, i.e., the face and core veneers. Also the total force required to strain the panel must be equal to the total of the forces in the component parts; therefore it can be shown that

$$E_{pa}\,\Delta_p\,t_p = t_t\,E_t\,\Delta_f + t_c\,E_c\,\Delta c$$

where E_{pa} = Modulus of elasticity of the panel
Δ_f = Strain of the face veneers
Δc = Strain of the core veneers
t_f = Total thickness of face veneers
t_c = Total thickness of core veneers
t_p = Thickness of panel

but since $\Delta P = \Delta_f = \Delta c$

$$E_{pa} = \frac{t_t}{t_p}\ E_f + \frac{t_c}{t_p}\ E_c$$

Employing the same reasoning that the deflection of each veneer in a panel must be equal to the deflection of the panel, and assuming elastic properties of veneers up to failure, a simple method may be applied to a panel to determine allowable tension and compression stresses for the separate veneers. Assuming that all veneers in the panel are of the same species and where

ΔL = deflection of veneers with grain longitudinal or in direction of applied load
ΔT = deflection of veneers with grain transverse or perpendicular to direction of load
f_p = stress in panel
f_l = stress in longitudinal veneers
f_t = stress in transverse veneers
t_L = total thickness of longitudinal veneers
t_T = total thickness of transverse veneers
t_p = total thickness of panel
E_L = modulus of elasticity of longitudinal veneers
E_T = modulus of elasticity of transverse veneers

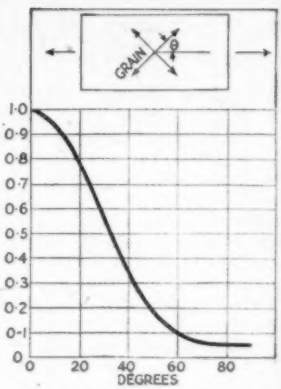


Fig. 20. Variation of mod. of elasticity with grain angle.

Then $f_p\,t_p = f_L\,t_L + f_T\,t_T$, but $f_L = \Delta L\,E_L$ and $f_T = \Delta T\,E_T$, solving for a relationship between f_L and f_T since $\Delta L = \Delta T$

$$\frac{f_L}{f_T}\ \frac{E_L}{E_T}$$ Therefore $f_p\,t_p = f_L\,t_L + f_L\,\frac{E_T}{E_L}\,t_T$

The above reasoning is due to Parsons, who states that the assumption that elastic qualities hold up to failure should not cause too great an error since the elastic limit of wood is quite close to the ultimate. Also the ratio of E_L/E_T appears to be greater than the ratio of modulus of rupture longitudinally to modulus of rupture transversely.

If the construction of the panel is such that the longitudinal veneers are of different species, the strength of the panel is evidently dependent upon the strength of the weaker species, and the allowable strength of the stronger veneer must be reduced so that $f_L = (E_L/E_L^1)\,f_L^1$.

Computation of the moment of inertia and section modulus of plywood panels of a rectangular cross-section are given in Fig. 19.

Tests on plywood with various grain angles to the direction of load have demonstrated that the effect of grain angle is pronounced and must be considered in calculating fuselage section properties. The subject is dealt with by L. J. Marhoefer, Chief Engineer, Vidal Research Corporation.† In the graph, Fig. 20, the variation of E with grain angle is presented as a start towards the evaluation of such data.

The concluding article in this series will be published next week.

* From paper presented at the Semi-Annual A.S.M.E. Meeting by G. B. Parsons, Cleveland, U.S.A. June 8th-10th, 1942.

† Design considerations for Plywood Structures—III. L. G. Marhoefer. Aviation. Jan. 1943.

TABLE 15.
PLYWOOD PANELS OF RECTANGULAR CROSS SECTION.

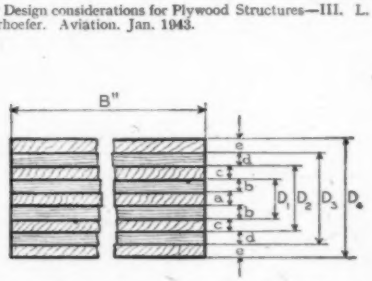
Computation of Moment of Inertia and Section Modulus.
Moment of Inertia $I = (K_1 B)/12$ Section Modulus $R = (K_1 B)/(6K_2)$

Grain of Face Plies Parallel to Span.

No. of plies in panel.	K_1.	K_2.
3	$D^3_1 = a^3$	D_1
5	$D^3_2 = (a+2b)^3 + a^3$	D_2
7	$D^3_3 = (a+2b+2c)^3 + (a+2b)^3 - a^3$	D_3
9	$D^3_4 = (a+2b+2c+2d)^3 + (a+2b+2c)^3 - (a+2b)^3 + a^3$	D_4

Grain of Face Plies at Right Angles to Span.

No. of plies in panel.	K_1.	K_2.
3	a^3	a
5	$(a+2b)^3 - a^3$	(a+2b)
7	$(a+2b+2c)^3 - (a+2b)^3 + a^3$	(a+2b+2c)
9	$(a+2b+2c+2d)^3 - (a+2b+2c)^3 + (a+2b)^3 - a^3$	(a+2b+2c+2d)



Cross-section of plywood panel with plane of plies at right angles to direction of load.
D_1 = Thickness of 3-ply panel in inches.
D_2 = Thickness of 5-ply panel in inches.
D_3 = Thickness of 7-ply panel in inches.
D_4 = Thickness of 9-ply panel in inches.

Fig. 19. Diagram for Table 15. Computation of moment of inertia and section modulus.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

INSTRUCTORS' DILEMMA

Regulations that Deny Experience

ON reading the report of the court martial held at Devonport on a Fleet Air Arm instructor, I feel that there is room for a change in the regulations. Lt. Cdr. C. Campbell-Horsfall stated that this instructor had an extremely good flying record and that the regulation imposing a ban below 2,000ft. is out of date for present naval requirements.

Here we have a case of an instructor teaching what he knows, from his own experience, to be vastly important, but, owing to an accident, he is severely dealt with for so doing. The fact that he was four miles outside his area sounds a lot, as far as miles are concerned, but it only means approximately two and a half minutes in a Moth It seems to me that there is little justice in this man being so treated when you consider the following facts.

My own son was posted to a Hurricane Conversion course in November, 1939. On his arrival he was given written instructions that he was forbidden to attempt aerobatics in a Hurricane until he had 50 hours' straight flying to his credit, this to be endorsed by his instructor in his log. Having completed 11 hours' straight flying, he was posted to a Fighter Squadron with the Advanced Air Striking Force in France. The first time he went into action (January, 1940), to save his own life and also the lives of his co-pilots, he had to attempt the aerobatics he was forbidden to attempt in England—with the same number of flying hours—and for which he would presumably have been court martialled.

I think, Sir, it would be interesting if you asked the past pupils of this F.A.A. instructor to write you (under the promise of secrecy), stating how many times they had saved their lives and been enabled to carry out some operation owing to the fact that their instructor *had* taught them low-flying tactics.

PATER.

AIR POLICY

Lessons from North Africa

WITH the successful completion of the African campaign, a number of people have started agitating for a separate air force attached to the Army and under the direct command of the military commander in the field. They hold that the successful blending of the air and land forces in the land campaign is but a portent of what real integral co-operation can achieve. The air forces would be exploited in clearing a path for the mechanised forces and in ensuring that our troops are able to fight free from fear of enemy air interference.

There is a very great danger in this prejudiced outlook. Air power is in danger of being wasted as a sort of glorified long-range artillery harnessed to the mechanism of a land-bound army. If this view is persisted in, air power will lose its greatest asset, that of flexibility and adaptability.

The fiasco of the German rout in Tunisia showed the futility of the army-bound air force. For all their specialised equipment (dive-bombers, etc.), the *Luftwaffe* was unable not only to impede our advance but also it was unable to protect the German troops from the weight of our air onslaught.

The best method of co-operation with the Army would appear to be as in North Africa, a strategic and a tactical air force under the command of an air officer in charge, who in turn would be responsible to a senior air officer who would work alongside of the Army and Navy commanders.

The strategic air force would be composed of day and night heavy bombers to bombard the enemy's ports, marshalling yards, dams, canals, manufacturing towns and other targets not immediately around the battlefront, but within a radius of 200-300 miles around it. In addition to these bomber squadrons there would be squadrons of fast, heavily armed long-range fighters to escort the day bombers and to carry out intruder operations over his base aerodromes at night.

It will be seen that the strategic air force is not immediately concerned with the actual battle line. Its job is to impair or destroy the enemy's power to supply his front-line troops with the sinews of modern war.

The tactical air force, on the other hand, is only concerned with the air operations over and around the actual battle area. It would be composed primarily of many squadrons of fast, high- and medium-altitude fighters to ensure complete air supremacy over the battle area. Also there would be many squadrons of fast medium bombers and fighter bombers, and together with the ground strafing and tank-busting squadrons, these squadrons would operate from the foremost front-line airfields close to the battle line.

The dive bomber, it will be noticed, has been given no place in the composition of the tactical air force. The dive bomber is ineffective against fast-moving tanks and armoured vehicles which are mostly heavily armoured on top. Therefore a direct hit will not necessarily "knock out" any tank hit. The fast fighter bomber and the heavy cannon (40 mm.) fighter-strafer can project their missiles horizontally into the most vulnerable part of a tank—namely, its wheels, tracks, etc. Against troops also the dive-bomber is at a disadvantage. Admittedly, it can carry a respectable load, but in a dive attack an aircraft changes position relatively slowly, thereby offering a good target to A.A. guns, particularly light A.A. Compare this with the low-flying fighter bomber carrying two 500-lb. bombs and armed with twelve guns with a terrific rate of fire, and it will be seen that the dive bomber is definitely out. Below is a list of what appear to be the best aircraft for the jobs listed above.

STRATEGIC AIR FORCE

Day Bomber—Fortress, Liberator.
Escort Fighter—Lightning.
Intruder Fighter—Mosquito II.
Long Range Reco Bomber—Mosquito IV

TACTICAL AIR FORCE

Medium Bomber—Mitchell, Baltimore.
Fighter Bomber—Hurricane IIB, Typhoon IB.
Ground Strafer—Hurricane IIB, Beaufighter.
Tank Buster—Hurricane IIB.
High Altitude Fighter—Spitfire IX.
Medium Altitude Fighter—Spitfire VB.
Low Altitude Fighter—Spitfire VB (clipped wings).
Fast G/P Artillery Spotter—Mustang.

H. ARCHER.

TOPICS OF THE DAY

Jews Part in the War

"INDICATOR," in his amusing article on "The Psychology of Slang," gives a stab in the back to the many thousands of Jews now serving in the British and Allied Forces. This will certainly please Dr. Goebbels, but why does your talented contributor so irrelevantly introduce racial intolerance into an otherwise excellent dissertation on Service slang?

He blandly implies that all "blacketeers" are Jews. We all know that certain Jewish scallywags have been active in the black market, but there have been a very large number of non-Jews in these rackets. *Every* community has some unscrupulous egoists ready to batten on the sacrifices of others. The proper thing to do with profiteers, whether Christian, Jewish, or other, is to punish them with the full rigour of the law and make it impossible for them ever to injure their fellow-citizens again. This is, in fact, steadily being done, and in carrying out their cleansing task the authorities have the wholehearted support of every decent Jew.

But to hold up a few cunning rats as in any way typical of Jewry is to play the Nazis' game for them and incidentally to slander a community the overwhelming majority of whose members are doing their duty. The number of black-market criminals is a drop in the ocean compared with the total of Jews serving in the various forces, while the number who have been decorated and/or become casualties is large and grows daily. Why, then, does not "Indicator" indicate the latter class as characteristic Jews? To do so would be far truer than to select as types those dregs which *all* communities contain, and would also display that sense of proportion which "Indicator" rightly commends.

"Indicator" says he is anxious to preserve the British "reputation for fairness, generosity, and good nature." He will therefore appreciate that it is just as true to say that Jews in the fighting line are protecting non-Jewish profiteers as the reverse. He also appeals for a pleasanter England after the war. In spreading race prejudice (strange occupation for a lover of fairness, generosity and good nature), what sort of a country does he imagine he is preparing for the fighting men of this persecuted race who are now helping to protect *him* from Nazi domination? I leave this little problem to the sense of humour of which "Indicator" is so justly proud.

Finally, "Indicator" is misleading his readers if he leads them to conclude that by getting rid of Jews they will get rid of black markets. Black markets are more rampant to-day in Axis countries than anywhere else, but they are certainly not run by Jews!

"MACCABEE, R.A.F."

SERVICE AVIATION

WAR AND PEACE: Haymaking at the dispersal points of a Halifax station.

Royal Air Force and Fleet Air Arm News and Announcements

Command Appointments

AIR VICE-MARSHAL RODERIC MAXWELL HILL, C.B., M.C., A.F.C., has been appointed Air Officer Commanding No. 12 (Fighter) Group. Until taking up this new appointment Air Vice-Marshal Hill had been commandant of the R.A.F. Staff College since September, 1942. Previously he served at the Air Ministry as Director of Technical Development and also as Director General of Research and Development.

He gained the M.C. and A.F.C. while serving as a pilot in the Royal Flying Corps, and in 1922 received a Bar to the A.F.C.

* * *

AIR VICE-MARSHAL BRIAN EDMUND BAKER has been appointed Air Officer Commanding No. 19 (Coastal Command) Group. Since July last he had commanded No. 16 Coastal Command Group, to which he was appointed after four months in command of the R.A.F. in Iceland. The Air Vice-Marshal, who is 47 won the D.S.O. in the last war as a pilot.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

Distinguished Service Order

Act. Sqn. Ldr. G. B. WARNES, D.F.C., No. 263 Sqn.—Since the award of the D.F.C. this officer has been engaged on numerous operational sorties, both by day and night, which have included low level attacks on heavily defended railway targets and attacks on enemy shipping. One night in May, 1943, Sqn. Ldr. Warnes participated in the destruction of a medium sized motor vessel.

Act. Flt. Lt. C. B. WALKER, R.A.A.F., No. 461 (R.A.A.F.) Sqn.—One day in June, 1943, Flt. Lt. Walker and F/O. Simpson were captain and navigator respectively, while Flt. Sgts. Fuller and Goode were gunners in a Sunderland flying boat which was attacked by eight Ju 88s when in the Bay of Biscay. The flying boat sustained much damage and a fire was started which caused burns to Flt. Lt. Walker. Nevertheless, this officer continued the engagement, and due to the superb teamwork of F/O. Simpson, who acted as fire controller, and Flt. Sgts. Fuller and Goode, three of the attacking aircraft were destroyed and two others were severely damaged. Despite his burns, Flt. Lt. Walker, ably assisted by the skilful navigation of F/O. Simpson, who was wounded in both legs, successfully flew his aircraft nearly 300 miles back to this country.

Bar to Distinguished Flying Cross

Act. Wing Cdr. H. N. G. WHEELER, D.F.C., and F/O. R. A. IRVING, D.F.C., R.A.F.V.R., both of No. 236 Sqn.—Wing Cdr. Wheeler has led a wing in five attacks on enemy shipping during which many thousands of tons have been sunk. During these operations, F/O. Irving, as the navigator of Wing Cdr. Wheeler's aircraft, displayed a high standard of ability and proved a valuable asset.

Distinguished Flying Cross

F/O. K. M. SIMPSON, R.A.A.F., No. 461 (R.A.A.F.) Sqn.—For citation see Flt. Lt. Walker, D.S.O.

Act. Sqn. Ldr. L. E. LOGAN, R.C.A.F., No. 405 (R.C.A.F.) Sqn.

Flt. Lt. K. J. BOLTON, No. 102 Sqn.

P/O. H. J. JENNINGS, R.C.A.F., No. 405 (R.C.A.F.) Sqn.

F/O. F. WESTON, R.A.F.V.R.—This officer has displayed the utmost devotion to duty and determination during many operational flights against heavily defended targets in France, Germany and Italy. These have included Cologne, Berlin, Bremen and Turin.

F/O. A. E. C. WHEELER, R.A.F.V.R., No. 21 Sqn.—Before joining this squadron, F/O. Wheeler completed several night intruder sorties, and since then has participated in a number of bombing raids, including the attack on the Philips Works at Eindhoven.

F/O. A. G. WILLIAMS, No. 464 (R.A.A.F.) Sqn.—This officer, now serving on his second tour of operational duty, has completed a large number of operational sorties. Invariably F/O. Williams has been a most valuable member of air crew.

F/O. K. WILLIAMS, R.A.F.V.R., No. 166 Sqn.—F/O. Williams has shown outstanding determination to achieve his objective, despite the physical handicap of air sickness. A first-class navigator, he has many times saved his aircraft, and always inspires his crew with confidence.

P/O. J. M. BAILEY, R.N.Z.A.F., No. 75 (N.Z.) Sqn.—P/O. Bailey always attacks his targets with skill and determination, and has taken part in missions over very heavily defended areas in enemy territory, such as Berlin, Cologne, Turin and Essen.

P/O. H. C. BECKMAN, R.A.F.V.R., No. 21 Sqn.—P/O. Beckman's sorties have included formation attacks in daylight on several heavily defended enemy targets such as Eindhoven, Brest and Cherbourg. He recently destroyed a Fw 190.

P/O. J. K. BELL, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—P/O. Bell has completed a large number of operational sorties against some of the most heavily defended targets in enemy territory, including Lorient, Munich, Hamburg, St. Nazaire and the Ruhr. On one occasion in August, 1942, his aircraft was badly damaged by an enemy night fighter just prior to reaching the target. Despite this the mission was successfully completed. With one engine useless and whilst over the sea the pilot experienced considerable difficulty in holding the rudders. P/O. Bell immediately came to his assistance, and by his co-operation and calmness contributed in a large measure to the safe return of the aircraft.

P/O. R. C. BERRY, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—In the capacity of wireless operator/air gunner, this officer has displayed commendable courage and devotion to duty. In July, 1942, when returning from an attack on Dusseldorf, his aircraft was attacked by an enemy fighter, which was destroyed after a ten-minute combat.

P/O. K. BRIERLEY, R.A.F.V.R.—This officer has taken part in mine-laying operations and attacks against some of the enemy's most heavily defended targets. Invariably he has displayed the utmost determination to complete successfully his tasks.

P/O. J. COBB, No. 218 Sqn.—As captain of aircraft, P/O. Cobb has taken part in numerous operations over targets in Germany, Italy and occupied enemy territory. In February, 1943, while attacking Cologne, his aircraft was damaged by severe anti-aircraft fire. One engine became unserviceable, but, despite this, P/O. Cobb bombed the target successfully and returned to base in safety, although a second engine failed. Again in March, 1943, his aircraft was badly damaged by anti-aircraft fire while over Essen. On this occasion also a successful landing was accomplished at base.

P/O. L. H. G. COLES, R.A.F.V.R., No. 61 Sqn.—This officer has flown on a large number of successful sorties, in the course of which he has consistently shown a high sense of responsibility and efficiency. His skill in guiding the aircraft in the vicinity of the target has been of the highest standard.

P/O. L. CROOK, R.A.F.V.R., No. 218 Sqn.—In February, 1943, during an attack on Turin, this officer was the rear gunner in an aircraft which was intercepted and attacked by an enemy night fighter. The enemy fighter made four attacks, but this officer's excellent commentary enabled his captain to manœuvre his aircraft into a position from which P/O. Crook was able to get in a long burst at close range causing the attacker to go down in flames.

P/O. L. CUDDINGTON, R.C.A.F., No. 61 Sqn.—An outstanding air gunner, P/O. Cuddington has always maintained a keen and accurate look-out. He has participated in a very large number of attacks against some of the enemy's most heavily defended targets, including Berlin, Essen and Turin.

P/O. M. E. C. CUELENAERE, R.C.A.F., No. 97 Sqn.—P/O. Cuelenaere has taken part in many operational sorties, which have included some long distance flights to Italy and attacks against some of the most heavily defended targets, including those in Berlin, Essen, the Ruhr and Western Germany.

P/O. K. DANDEKER, R.A.F.V.R., No. 51 Sqn.—This officer has participated in bombing raids and anti-submarine patrols. On returning from his first operational sortie he had to leave his aircraft by parachute while over the United Kingdom and broke his ankle. Although out of action

for four months as a result of this hazardous experience, P/O. Dandeker's enthusiasm for operational flying remained undiminished, and he completed a long and praiseworthy tour of operations.

P/O. E. G. DUDLEY, R.A.F.V.R., No. 44 Sqn.—This officer has displayed the utmost enthusiasm for his duties as air gunner. He has taken part in many sorties against distant and heavily defended enemy targets.

P/O. L. G. EXTON, R.A.F.V.R., No. 76 Sqn.—This officer has participated in a large number of operational sorties, some of which have been against the enemy's most heavily defended targets, including Berlin, Essen and Duisburg.

P/O. J. A. FAIRLEY, R.C.A.F., No. 61 Sqn.—This officer has taken part in numerous sorties against such distant and strongly fortified targets as Essen, Hamburg, Cologne, Turin and Spezia. Throughout these attacks his cool courage under heavy anti-aircraft fire has been exemplary.

P/O. T. GALLANTRY, R.A.F.V.R., No. 76 Sqn.—This officer has completed numerous successful operational sorties. Among the targets which he has attacked have been the heavily defended areas of Hamburg, Berlin, Essen and Duisburg.

P/O. D. B. GAUNT, R.A.F.V.R., No. 214 Sqn.—P/O. Gaunt's operational missions have included sorties against such heavily defended targets as Berlin, Hamburg, Turin and Genoa. He has experienced attacks by enemy night fighters on several occasions. These have invariably been beaten off or evaded successfully as a result of the skilful directions given by P/O. Gaunt.

P/O. R. M. HETHERINGTON, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—P/O. Hetherington has been flying on operations continuously since May, 1942. He has participated in attacks on some of the most heavily defended targets in Germany, Italy and occupied France, including the Ruhr and Berlin. He also took part in the "1,000-bomber" raid on Cologne.

P/O. W. J. HORNE, R.A.F.V.R., No. 105 Sqn. (since deceased).—During his career of operational duties, this officer has participated in a large number of missions. Among his recent operations have been successful attacks on Le Mans, Lingen, Tours and Hengelo.

P/O. G. W. LANCEY, R.C.A.F., No. 97 Sqn.—The majority of the sorties completed by this officer have been successful attacks on such targets as Hamburg, Bremen and the Ruhr. As captain of aircraft, he has also taken part in sorties against Genoa and Turin and in many effective minelaying flights.

P/O. I. Le R. LAUCKNER, R.C.A.F., No. 405 (R.C.A.F.) Sqn.—In November, 1942, while on an anti-submarine patrol, this officer pressed home a telling attack on a U-boat, despite very heavy fire from two enemy minesweepers. In attacks over heavily defended areas in Germany and Italy, P/O. Lauckner has also given evidence of his outstanding ability in directing evasive action.

P/O. E. W. LOVEJOY, R.A.F.V.R., No. 57 Sqn.—Whilst operating with this squadron against enemy targets, P/O. Lovejoy has invariably displayed a high degree of keenness, courage and professional ability as a navigator. Amongst the sorties in which he has participated have been attacks on the most strongly defended and distant targets in Germany and Italy.

P/O. J. J. MCGAVOCK, R.C.A.F., No. 426 (R.C.A.F.) Sqn.—This officer has taken part in numerous attacks against all types of enemy targets, including such heavily defended areas as Hamburg, Mannheim, Essen, and Cologne. He has also participated in several successful minelaying operations.

P/O. L. E. MCKENZIE, R.A.F.V.R., No. 57 Sqn.—P/O. McKenzie has completed many operational sorties, including six of long distance. A navigator of outstanding ability by his keenness and untiring efforts he has very largely contributed to the successes achieved.

Three Ju 88s

P/O. E. J. MCLENNAN, No. 218 Sqn.—Early in his flying career, during a flight to Kiel, this officer was responsible for the destruction of three Ju 88s on the ground at an enemy airfield. In September, 1942, while on operations against Munich, the bomber in which P/O. McLennan was flying as air gunner was subjected to heavy anti-aircraft fire and severely damaged. Several of the crew were injured, and a little later the aircraft was attacked by an enemy night fighter and only the cool courage displayed by P/O. McLennan succeeded in driving it off.

P/O. G. S. MCMENENY, R.C.A.F., No. 426 (R.C.A.F.) Sqn.—This officer has participated in numerous sorties against all types of targets in enemy territory and also in minelaying patrols in enemy waters. His objectives have included Essen, Mannheim, Kiel and Duisburg. P/O. McMeneny has invariably displayed exceptional determination to press home his attacks on the enemy and has produced photographs which amply illustrate the success of his attacks.

P/O. E. V. MILLER, R.C.A.F., No. 214 Sqn.—This officer has participated in many operational sorties and has always shown persistent determination to bomb his target and bring back photographs of the aiming point. In March, 1943, during an attack on Stuttgart, the port outer engine of P/O. Miller's aircraft failed and his port inner engine became overheated. Despite these handicaps, with great skill he flew safely back to base.

P/O. J. R. PRICE, R.C.A.F. No. 408 (R.C.A.F.) Sqn.—Since joining this squadron, P/O. Price has participated in numerous operational sorties over well-defended enemy objectives such as Berlin, Emden, Rostock and Turin. He has led his pilot to these targets with cool judgment and determination, often securing photographs which display a fine record of achievement. One night in March, 1943, while returning from Stuttgart, his aircraft was severely damaged in an encounter with an enemy fighter. Although two engines were put out of action, this officer unerringly navigated the aircraft which made a safe landing at base.

P/O. T. OAKES, D.F.M., R.A.F.V.R., No. 83 Sqn.—P/O. Oakes has completed a large number of successful operational sorties. During a raid on Munich in December, 1942, the aircraft of which he was captain was attacked five times by an enemy fighter. The bomb bay was set on fire and several of the crew severely injured. P/O. Oakes displayed great coolness and directed his crew so skilfully that the flames were extinguished, bombs jettisoned, and the fighter shaken off. While still engaged in flying the badly damaged aircraft back to base, this officer was of great assistance in giving first aid to the wounded.

P/O. J. W. PATTERSON, R.C.A.F., No. 61 Sqn.—This officer has completed a large number of operational sorties, throughout which his excellent navigation has materially assisted in the

SERVICE AVIATION

Flt. Lt. H. D. Macdonald, of No. 403 (R.C.A.F.) squadron, who has been awarded the D.F.C.

successes achieved, particularly when operating against long-distance and well-defended targets such as Berlin, Nuremberg, Danzig and Turin.

P/O. R. S. RAYMOND, R.A.F.V.R., No. 44 Sqn.—On all occasions this officer has shown the greatest determination in locating and bombing his target. P/O. Raymond has taken part in attacks on the enemy's most important and heavily defended targets.

P/O. H. D. REEDER, R.A.F.V.R., No. 51 Sqn.—P/O. Reeder has completed a number of bombing sorties and 21 anti-submarine patrols in daylight. As wireless operator, his technical skill has on more than one occasion ensured the safe return of his aircraft when navigational difficulties have been encountered.

P/O. T. H. REEVES, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—P/O. Reeves has completed a large number of operational sorties, many of them directed against heavily defended targets such as Cologne, Essen and Bremen. In July, 1942, while returning from Hamburg, his aircraft, which had been damaged by anti-aircraft fire over the target, was attacked twice by a Ju 88. On the second occasion, P/O. Reeves hit the attacking aircraft. It turned over on its back and was last seen diving steeply.

P/O. R. A. RIGGS, R.A.A.F., No. 78 Sqn.—P/O. Riggs has completed a successful tour of operational duty. His sorties have included raids on many of the most heavily defended towns in Germany, and he has twice bombed Genoa.

P/O. J. W. ROCH, No. 7 Sqn.—This officer has completed 26 operational missions as wireless operator in heavy aircraft. He has taken part in raids on strongly defended targets in enemy territory, including Berlin, Hamburg and Turin.

P/O. F. G. RUMBLES, No. 97 Sqn.—This officer has completed numerous successful sorties as navigator. His targets have included Berlin, Essen, and many other strongly defended German and Italian centres, where extremely accurate navigation has been essential.

P/O. M. E. H. SMITH, R.A.A.F., No. 97 Sqn.—This officer has completed a successful operational tour as navigator. He has participated in many raids on heavily defended objectives in Germany and Italy, including such distant targets as Mannheim, Genoa and Turin.

P/O. G. B. TAIT, R.C.A.F., No. 15 Sqn.—P/O. Tait has taken part in 25 operational sorties, during which he has displayed navigational skill of the highest degree. His trips have included raids on Kiel, Cologne, Stuttgart, Turin and Genoa.

P/O. H. F. MCP. TAYLOR, C.G.M., No. 156 Sqn.—On four occasions this officer's aircraft has sustained damage from the ground defences, but, in spite of this, he invariably presses home his attacks with coolness and tenacity. Since his last award he has completed numerous sorties which have included two attacks on Berlin.

P/O. N. J. WADDINGTON, R.A.A.F., No. 207 Sqn.—This officer has participated in attacks on the majority of the enemy's most heavily defended targets, including Berlin and in the daylight raid on Le Creusot. On all occasions when faced with heavy opposition P/O. Waddington has displayed coolness and determination of the highest degree.

W/O. (now P/O.) H. W. BENNETT, No. 97 Sqn.—W/O. Bennett has participated in many successful sorties against the most heavily defended German targets. He has also completed long distance flights and mine-laying missions, where, owing to adverse weather, a high degree of navigational skill was required.

W/O. K. L. O. BLOW, No. 487 (N.Z.) Sqn.—W/O. Blow has completed a very large number of operational sorties, comprising anti-submarine patrols, shipping reconnaissances, mine laying operations, and, more recently, daylight bombing raids.

Incendiary in Fuselage

W/O. A. B. BOYLE, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—A fine operational captain of aircraft, W/O. Boyle has completed a large number of successful sorties over Germany, Italy and occupied France, including attacks on heavily defended targets at Berlin and Essen. On one occasion, during an attack on St. Nazaire, W/O. Boyle's aircraft was struck by a falling incendiary, which ignited inside the fuselage during the bombing run. Nevertheless, this airman completed his attack before attempting to deal with the incendiary.

W/O. (Now F/O.) J. L. N. CANHAM, No. 97 Sqn.—W/O. Canham has flown on a large number of successful sorties against some of the most heavily defended targets in Germany. He also took part in the daylight attack on Danzig.

W/O. (Now P/O.) E. C. MCCLELLAND, R.C.A.F., No. 106 Sqn.—W/O. McClelland has navigated his aircraft with skill and determination over heavily defended territory to targets in widely scattered parts of Germany and occupied territory, including Danzig, Bremen, Berlin, Lorient, the Ruhr and Italy, and on the daylight attack on Milan. In addition, he has been largely responsible for the success of long-distance minelaying sorties.

W/O. S. J. RICKETTS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—This airman has taken part in a large number of operational sorties, the majority of which have been against the enemy's most heavily defended targets in Germany, Italy and Occupied France. He has obtained some excellent photographs.

W/O. A. G. ROACH, No. 138 Sqn.—W/O. Roach has completed a large number of operational sorties. He has participated in shipping sorties over the North Sea and Heligoland, and also in attacks on Bremen, Essen and Cologne.

W/O. (now P/O.) C. S. SANDERSON, No. 44 Sqn.—This pilot has completed a large number of operational sorties, many of them over very heavily defended and distant targets. He has exhibited efficiency and enthusiasm both in planning and executing his missions.

W/O. C. L. TAYLOR, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—W/O. Taylor has performed his duties with a high degree of skill and initiative, and a large measure of the successes achieved can be attributed to this airman's fine navigational skill.

W/O. (now P/O.) J. F. W. TOWSE, R.C.A.F., No. 102 Sqn.—W/O. Towse has a long operational record of attacks against a wide variety of targets, and has been conspicuous for sustained courage, determination and endurance.

Act. W/O. D. C. A. SAUNDERS, R.A.F.V.R., No. 156 Sqn.—W/O. Saunders has completed numerous operational sorties against targets in Germany, Italy and enemy occupied territory. As bomb-aimer this airman was always displayed the most outstanding efficiency, invariably returning with excellent photographs.

Act. W/O. (now P/O.) W. SENGER, R.C.A.F., No. 7 Sqn.—A most able operational captain of aircraft, W/O. Senger has many successful sorties to his credit. With cool courage he has taken part in attacks against targets in Germany and Italy, resolutely pressing home his attacks despite the heaviest opposition.

F/O. A. J. PHILLIPS, R.A.A.F., No. 227 Sqn.—F/O. Phillips has completed numerous operational sorties, including several successful shipping strikes and low-level attacks on enemy communications in Tunisia and Sicily. He has also attacked several formations of enemy aircraft between Tunis and Sicily. In May, 1943, he was flying in one of three aircraft which attacked five Ju. 52's and five Arado 196s. In the ensuing engagement F/O. Phillips shot down one enemy aircraft and later attacked and probably sank a 120-ton vessel. A few days later he participated in the destruction of a further two hostile aircraft and an 80-ton caique.

F/O. W. A. THYNNE, M.M., B.E.M., R.A.F.V.R., No. 272 Sqn.—This officer has participated in many and varied operational missions, which have included low-level machine gun attacks on enemy communications and night intruder patrols over Sicily and Southern Italy. In May, 1943, when flying on a reconnaissance near the Sicilian coast, his aircraft was attacked by a large number of enemy fighters. One hostile aircraft was

SERVICE AVIATION

damaged by fire from this officer's guns, and after a combat lasting 15 minutes, during which he gave most clear and accurate directions to his pilot, the enemy withdrew without scoring a hit.

Act. Sqn. Ldr. W. F. GIBB, R.A.F.V.R., No. 611 Sqn.—During one day this officer severely damaged seven locomotives in France. On another occasion, he led a section of three aircraft which engaged two Ju 88s over the Bay of Biscay. Owing to his skilful leadership both of the enemy aircraft were destroyed.

Act. Flt. Lt. F. F. COLLOREDO-MANSFELD, R.A.F.V.R., No. 611 Sqn.—This officer has led his flight, and on occasions the squadron, on 81 operational sorties, during which he has shown great skill and keenness. He has destroyed one enemy aircraft.

F/O. G. H. F. CARTER, R.C.A.F., No. 35 Sqn.—In air operations this officer has displayed courage, initiative and fortitude in keeping with the highest traditions of the R.A.F.

F/O. A. K. HODGE, R.A.F.V.R., No. 227 Sqn.—F/O. Hodge has taken part in numerous sorties which have included shipping strikes and low level bombing and machine gun attacks against targets in Sicily and Tunis. He has destroyed one enemy aircraft of six which have been shot down by members of the crew of his aircraft.

F/O. A. LEE-WHITE, R.A.F.V.R., No. 263 Sqn.—This officer has taken part in numerous and varied offensive operations, a number of which have been at night. His sorties have included attacks on shipping and industrial targets. On one occasion, when attacking enemy vessels in convoy, the starboard engine in his aircraft was set on fire. Undaunted, he bombed an armed trawler before successfully flying back to this country, where he made a safe landing while the fire still burned in the engine.

P/O. M. T. COTTON, R.A.A.F., No. 263 Sqn. (since missing).—P/O. Cotton has taken part in numerous and varied operational missions, some of which have been completed at night. His sorties have included bombing attacks on enemy airfields, attacks on railway objectives and against shipping in convoy. On three occasions his aircraft has been seriously damaged by anti-aircraft fire, but he did not fail to fly back to this country and to land safely.

Act. Wing Cdr. W. O. V. BENNETT, A.F.C., No. 143 Sqn.—Wing Cdr. Bennett has led his squadron with great determination in several attacks on enemy shipping, during which great success has been achieved.

Temp. Lt. Cdr. G. DOUGLAS, R.N.R.—This officer has taken part in a large number of offensive patrols, and has displayed great skill and tenacity. One night in February, 1943, he participated in an attack on nine enemy motor boats. Although his aircraft was damaged by anti-aircraft fire from the vessels, Lt. Cdr. Douglas pressed home his attack and destroyed two of them. One night in May, 1943, his squadron attacked 12 R boats, four of which were destroyed and three more damaged.

Sqn. Ldr. W. P. GREEN, No. 85 Sqn.—This officer has displayed exceptional skill and determination in night flying operations during which he has destroyed two enemy aircraft. Sqn. Ldr. Green has displayed great courage and devotion to duty.

F/O. G. N. IRVING, R.A.F.V.R., No. 85 Sqn.—This officer has completed a very large number of hours flying on operations. He is an observer of exceptional merit and has shared in the destruction of two enemy aircraft at night.

Sub-Lt. (A) T. J. STANLEY, R.N.V.R.—As observer, this officer has taken part in a large number of attacks on enemy shipping. He has at all times displayed a high degree of skill and determination and has contributed materially to the successes obtained by his squadron.

F/O. C. L. F. TALALLA, R.A.F.V.R., No. 118 Sqn.—This officer has participated in a large number of sorties and has led his section with great skill and keenness. He has destroyed one enemy aircraft.

Sub-Lt. (A) E. M. WELCH, R.N.V.R.—This officer has participated in many attacks on enemy shipping and has invariably displayed great determination to ensure accurate bombing. One night in May, 1943, in an attack on a number of enemy R boats, Sub-Lt. Welch accomplished excellent work.

F/O. T. R. WILBY, R.C.A.F., No. 78 Sqn.—In air operations this officer displayed courage, fortitude and skill of the highest order.

F/O. F. C. D. WRIGHT, R.A.F.V.R., No. 254 Sqn.—This officer has completed a large number of sorties, involving escort duties, reconnaissances and attacks on shipping. He is a fearless pilot, whose keenness and efficiency have set a fine example.

Shot-up Over Duisburg

P/O. C. C. STOVEL, R.C.A.F., No. 408 (R.C.A.F.) Sqn.—This officer has completed many sorties, including attacks on well defended targets in the Ruhr. One night in April, 1943, he piloted an aircraft detailed to attack Duisburg. Whilst over the target area, one engine became unservicable but, in spite of this, P/O. Stovel pressed home a vigorous attack. Immediately afterwards, the bomber was hit by anti-aircraft fire and temporarily went out of control, losing considerable height. P/O. Stovel skilfully regained control, however, and eventually flew the aircraft to base.

Act. Flt. Lt. J. C. WELLS, No. 609 Sqn.—This officer has completed many hours' flying, involving sorties both by day and night. He has achieved much success in attacks on enemy lines of communication, while in air combat he has destroyed at least three enemy aircraft, two of which he shot down in one engagement.

F/O. C. W. BURCHER, R.A.A.F., No. 86 Sqn.—This officer has completed numerous sorties during which he has attacked ten U-boats. In a recent engagement in June, 1943, F/O. Burcher pressed home his attack with great determination in the face of severe gunfire from the vessel.

F/O. I. F. KENNEDY, R.C.A.F., No. 249 Sqn.—This officer has completed much operational flying, involving bomber escort flights, sweeps and bombing sorties. During an operation in April, 1943, F/O. Kennedy shot down a Ju. 52. A little later he saw many of these aircraft flying almost at sea level. F/O. Kennedy immediately attacked one of them, causing it to dive into the water with one engine on fire. This officer has destroyed five enemy aircraft.

P/O. R. H. TUPPER, R.C.A.F., No. 148 Sqn.—This officer has completed numerous sorties. He is a resourceful captain, whose unsurpassed skill and judgment have been largely responsible for the success obtained.

Flt. Lt. G. L. MANDENO, R.A.F.V.R., No. 156 Sqn.—This officer has completed 29 sorties. One night in June, 1943, he piloted an aircraft detailed to attack Munster. During the flight, the bomber was attacked by an enemy fighter but, although damage was sustained, making the bomber difficult to control, Flt. Lt. Mandeno continued to the target and bombed it. Five nights later, when returning from an attack on Cologne, his aircraft was hit by gunfire from an enemy aircraft. The elevator and the tailplane were damaged, one of the port engines was put out of action and a petrol tank was pierced. Despite this, Flt. Lt. Mandeno flew the bomber to base.

F/O. J. L. TEMPEST, R.A.F.V.R., No. 462 (R.A.A.F.) Sqn.—F/O. Tempest and Sgts. Curnow and Gordon were members of the crew of an aircraft engaged on a bombing operation one night in May, 1943. During the flight, the starboard inner engine failed and the pilot altered his course and flew out to sea where the bomb load was jettisoned. Soon, one of the port engines failed and, as the aircraft was gradually losing height, all movable equipment was thrown overboard. Deficient of power and battling against strong winds, the bomber was soon forced down to 1,000 feet when a third engine failed. In the face of a perious situation, these members of aircraft crew displayed great steadiness in the execution of their tasks and proved of assistance to their captain, who skilfully brought the aircraft down safely on a rough sea, causisg no injury to any of his crew, all of whom embarked safely in the dinghy. After ten and a half days the dinghy drifted ashore.

Act. Group Capt. G. J. GRINDELL, A.F.C., No. 487 (C.N.Z.) Sqn.—While flying on operations Group Capt. Grindell has always displayed a high standard of leadership and outstanding courage. He has attacked targets in enemy occupied territory such as Dunkirk docks, Rotterdam, and railway centres in France, sometimes in the face of very heavy opposition.

Act. Group Capt. R. H. WATERHOUSE, A.F.C.—After being engaged in training duties in Canada for some time, this officer has now been posted to command a bomber squadron. Although a station commander, he continues to operate as captain and sets a fine example to his air crews. He has participated in attacks on Emden, Duisberg, Lorient, Cologne, Wilhelmshaven and St. Nazaire.

Wing Cdr. H. M. CARSCALLEN, R.C.A.F., No. 424 Sqn.—Wing Cdr. Carscallen has been continuously employed on operations since the outbreak of war. He has displayed outstanding fortitude and skill during numerous operational sorties. Many of these were anti-submarine patrols involving long-distance flights of a hazardous nature. He has also participated in a number of bombing attacks.

Act. Wing Cdr. A. E. LOWE, M.B.E., No 77 Sqn.—The first air gunner to be appointed to command a squadron, this officer possesses courage, determination and devotion to duty equalled by few and surpassed by none. Wing Cdr. Lowe has participated in raids on highly defended European targets such as Cologne, Lorient, Berlin, and Stuttgart.

Act. Wing Cdr. T. R. HOPE, No. 158 Sqn.—This officer has commanded a bomber squadron for some time. He has taken part in a number of dangerous and difficult missions, including raids to Berlin, Essen and Cologne. During these sorties he has frequently secured excellent photographs, often in the face of violent opposition. His aircraft has been damaged on several occasions and he has destroyed one enemy fighter.

Three Ships

Act. Sqn. Ldr. W. H. ADAMS, R.C.A.F., No. 415 (R.C.A.F.) Sqn.—In May, 1943, this officer was pilot of a bomber detailed to attack a convoy off the Frisian Islands. The largest merchant vessel in this convoy was successfully attacked in spite of anti-aircraft fire. In July, 1942, this officer attacked and sank an enemy merchant vessel near the Dutch coast, and in November, 1942, he made a successful attack on an escorted merchant vessel in the Bay of Biscay.

Act. Wing Cdr. W. H. SHAW, R.A.F.O., No. 83 Sqn.—This officer commenced his operational career in September, 1939, and has since completed a large number of missions against enemy targets. His operational record has included bombing raids against such objectives as Bremen, Berlin, Essen and Hamburg.

Act. Wing Cdr. J. D. STEPHENS, R.A.F.O., No. 149 Sqn.—The coolness and determination displayed by this officer, while on operations over heavily defended targets, have been outstanding. He has taken part in operations over many difficult targets in the Ruhr and elsewhere with a devotion which has contributed materially to the successes achieved.

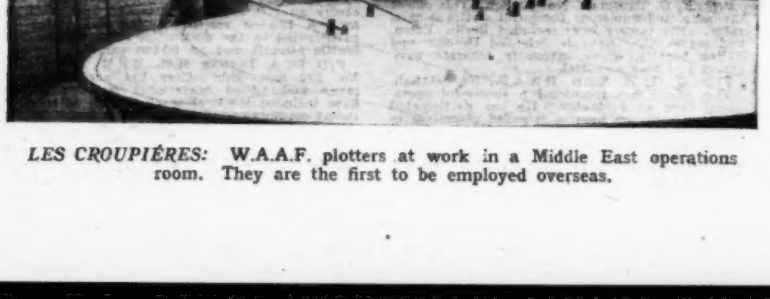
Act. Sqn. Ldr. E. W. ANDERSON, R.A.F.V.R.—This officer has maintained a very high standard of skill as a navigator and bomb-aimer. Many of his sorties have had as objectives the most heavily defended centres in enemy territory, and his enthusiasm for operational flying is such that he has never failed to place his bombs with the greatest possible accuracy. On many occasions valuable photographs have been secured.

F/O. J. E. MCCLURE, R.C.A.F., No. 137 Sqn.—This officer has completed much operational flying, including a number of reconnaissances and attacks on shipping. In attacks on the enemy lines of communication, F/O. McClure has destroyed a barge and caused damage to rolling stock.

Flt. Lt. J. S. M. BARKEL, R.A.F.V.R., No. 23 Sqn.—This officer has undertaken a large number of sorties. In a period of air operations in Tripolitania, Flt. Lt. Barkel destroyed many enemy vehicles. In Italy and Sicily he has attacked rail installations, locomotives and other targets with great success. On one occasion his bombing started a large fire in a railway siding at Metaponte and, on another occasion, he attacked a factory and caused violent explosions inside the building.

Act. Flt. Lt. G. B. CHRISTOPHERSEN, R.A.F.V.R., No. 221 Sqn.—This officer has completed many reconnaissances over the Mediterranean. On four occasions his skilful work has enabled successful attacks to be made on enemy shipping.

F/O. F. DEACON, R.A.A.F., No. 221 Sqn.—This officer has completed a large number of sorties, involving reconnaissances, anti-submarine patrols



LES CROUPIÉRES: **W.A.A.F. plotters at work in a Middle East operations room. They are the first to be employed overseas.**

and attacks on shipping. In February, 1943, he took part in a successful attack on a large tanker. On two subsequent occasions it was due to his efforts that enemy convoys were attacked.

Conspicuous Gallantry Medal (Flying)

W/O. H. VERTICAN, No. 462 Sqn.—This captain of aircraft has taken part in operational missions against targets in Greece, Crete, Sicily and North Africa. While engaged on a sortie in May, 1943, the starboard inner engine of his aircraft failed, and W/O. Vertican turned his aircraft and flew out to sea where the bombs were jettisoned. Soon the port inner engine failed, and as the aircraft was gradually losing height all equipment possible was thrown overboard. Deficient of power and battling against strong winds the bomber was soon forced down to a height of 1,000 feet when a third engine failed. W/O. Vertican was now faced with a perilous situation, but skilfully he brought the aircraft safely down on to a rough sea causing no injury to any of his crew, all of whom successfully embarked in the dinghy. After ten and a-half days the dinghy had drifted to shore. During all this time W/O. Vertican organised the consumption of the meagre rations, and did all he could to maintain the spirit of his companions at a high level, which contributed much to the survival of them all.

Flt. Sgt. N. F. WILLIAMS, D.F.M., R.A.A.F., No. 35 Sqn.—On a night in June, 1943, this airman was the rear gunner of an aircraft detailed to attack Dusseldorf. During the operation the bomber was intercepted by two enemy fighters. In the first encounter Flt. Sgt. Williams' turret was rendered unserviceable, while he sustained several bullet wounds in the legs and body. Nevertheless, when the second fighter attacked, Flt. Sgt. Williams skilfully gave his captain directions which enabled the fighter to be evaded. Flt. Sgt. Williams then delivered an accurate burst of fire which caused the enemy aircraft to explode in the air. The first fighter resumed the attack, but, although in considerable pain, with both legs partially paralysed, Flt. Sgt. Williams, with a well-placed burst of fire from close range, shot the enemy aircraft down. Making light of his injuries he remained in his damaged turret until a landing was effected, when his turret had to be cut away before he could be extricated.

Distinguished Flying Medal

Flt. Sgt. A. E. FULLER and Flt. Sgt. R. M. GOODE, R.A.A.F., both of No. 461 (R.A.A.F.) Sqn.—For citation see Flt. Lt. Walker, D.S.O.

Sgt. H. L. MCBEATH, R.C.A.F., No. 7 Sqn.—For citation see F/O. Carter, D.F.C.

Sgt. C. D. CURNOW, R.A.A.F., and Sgt. J. R. GORDON, No. 462 (R.A.A.F.) Sqn.—For citation see F/O. TEMPEST, D.F.C.

Sgt. M. A. T. DAVIES, No. 76 Sqn.

Sgt. W. R. LAWS, No. 102 Sqn.

Sgt. D. V. SMITH, R.C.A.F., No. 7 Sqn.

Sgt. M. B. STRANGE, No. 76 Sqn.

Sgt. D. BRESLIN, No. 106 Sqn.—This airman has taken part in many operational sorties, which have included missions to Duisburg, Berlin, Munich, and various Italian targets. One night in April, 1943, whilst over Duisburg, his aircraft was attacked by a fighter. Two very determined attacks were made, but the steady and accurate fire maintained by Sgt. Breslin damaged the assailant and caused it to break off the engagement.

Sgt. (Now P/O.) J. W. CARNEY, No. 467 (R.A.A.F.) Sqn.—This airman has taken part in attacks against the most heavily defended targets in Germany and enemy-occupied territory, including four attacks on Berlin and four on Essen. On his last sortie to Berlin, he was prevented by adverse weather from gaining the necessary height over the target, but this in no way deterred him from bombing the objective successfully.

Sgt. H. J. CARTER, No. 115 Sqn.—Sgt. Carter has taken part in many operational missions, several against the heavily defended targets in Germany, such as Duisburg, Essen, Hamburg and Berlin. He has also completed many mine-laying sorties.

Sgt. S. M. CHADWICK, No. 166 Sqn.—This airman took part as wireless operator/air gunner in the "1,000 bomber" raids on Cologne and the Ruhr, in addition to many other attacks on heavily defended targets. During these missions difficulties were frequently encountered, and on four occasions his aircraft sustained severe damage.

Sgt. A. W. CONNOR, R.A.A.F., No. 50 Sqn.—This airman has taken part in attacks on many of the most heavily defended targets in Germany. He also took part in the daylight raid on Le Creusot. In October, 1942, during a daylight attack in Milan, the aircraft in which Sgt. Connor was flying was severely damaged by anti-aircraft fire.

Sgt. D. CRAVEN, No. 15 Sqn.—This airman has completed a very large number of operational sorties, invariably displaying great ability and skill as a wireless operator. His keenness has at all times been of a high order, and his exemplary conduct worthy of the highest praise.

Sgt. H. E. MCALLISTER, No. 148 Sqn.—This airman has successfully completed many operational missions. Despite several hazardous experiences, his zeal for operational duties has remained unabated, whilst his courage, resourcefulness and endurance have been an inspiration to his comrades.

Sgt. A. A. SKINNER, No. 7 Sqn.—In May, 1943, Sgt. Skinner was the rear gunner of an aircraft detailed to attack a heavily defended enemy target. When nearing the objective the bomber was attacked by an enemy night fighter. Although painfully wounded about the head, face and left arm, Sgt. Skinner fought back repeated attacks, directing such accurate and telling fire that the enemy aircraft broke off the combat and appeared to fall out of control.

Sgt. R. H. WILLIS, No. 7 Sqn.—During an operational sortie one night in May, 1943, this airman's aircraft was engaged by an enemy fighter. Repeated attacks were made, during which Sgt. Willis and three members of his crew were wounded and the aircraft was severely damaged. Despite his wounds, Sgt. Willis kept control of the bomber and after skilfully evading the enemy fighter set course for home. He had no serviceable navigational instruments and steered a rough course by the stars. By skilful airmanship he successfully flew his damaged aircraft to this country, where he made a safe landing, and not until then did he report his wounds.

Flt. Sgt. E. J. HANN and Flt. Sgt. B. A. REYNOLDS, both of No. 254 Sqn.—As pilot and navigator respectively, Flt. Sgt. Hann and Reynolds have completed many sorties, including reconnaissances and attacks on enemy shipping.

Flt. Sgt. R. L. W. SMITH, No. 408 (R.C.A.F.) Sqn.—As wireless operator/air gunner, Flt. Sgt. Smith has taken part in a large number of sorties, including attacks on some of the most heavily defended targets in Germany.

Sgt. S. GAUNT, R.C.A.F., No. 426 (R.C.A.F.) Sqn.—One night in May, 1943, this airman was the captain of an aircraft detailed to attack Dortmund. During the operation, the bomber was repeatedly hit by anti-aircraft fire whilst illuminated by searchlights. The hydraulic and intercommunication systems were rendered unserviceable, whilst a fire broke out in the front turret and the cockpit filled with smoke. The flames were extinguished, however, and Sgt. Gaunt afterwards flew the damaged aircraft to this country.

Sgt. B. J. I. WALKER, No. 77 Sqn.—In air operations, Sgt. Walker displayed courage, skill and fortitude in keeping with the highest traditions of the R.A.F.

Flt. Sgt. D. T. BAGNARI, R.A.A.F., No. 459 (R.A.A.F.) Sqn.—This airman captained an aircraft which attacked and sunk a U-boat in June, 1943. Although his aircraft was badly damaged by blast, he flew it safely to base.

Flt. Sgt. G. H. WARD, No. 89 Sqn.—As observer, this airman has participated in many sorties in operations extending from Egypt to Tunisia. He has displayed great skill and courage throughout and has rendered fine service.

Sgt. J. F. BINNIE, R.A.A.F., No. 467 (R.A.A.F.) Sqn. (since reported missing).—On a night in June, 1943, this airman captained an aircraft detailed to attack Bochum. On the outward flight the bomber was twice attacked by fighters, but, displaying great skill, Sgt. Binnie succeeded in frustrating them on each occasion. Although the rear turret was rendered unserviceable and damage was sustained to the fuselage, the wings and the tailplane, Sgt. Binnie flew on to the target and bombed it successfully, afterwards completing the return journey and effecting a safe landing in spite of a punctured tyre on the port wheel.

Sgt. L. G. COLLINS, R.C.A.F., No. 432 (R.C.A.F.) Sqn.—This airman was the navigator of an aircraft which attacked Dortmund on a night in May, 1943. Whilst over the target area, Sgt. Collins was wounded in the head and sustained a fracture of the skull. Although weakened by the loss of blood, he refrained from informing his captain of his injury until the target had been bombed and the aircraft was well clear of the area. Displaying outstanding fortitude, Sgt. Collins calmly executed his duties and plotted courses for the homeward flight. He did not desist until a safe landing had been effected, when he collapsed and was removed to hospital in a semi-comatose condition.

Sgt. A. N. STOCKDALE, No. 70 Sqn.—This airman has completed a large number of sorties and has displayed praiseworthy skill and tenacity throughout. This was amply demonstrated on one occasion when attacking a heavily defended concentration of vehicles in the vicinity of Mareth. In spite of considerable anti-aircraft fire and searchlight activity, Sgt. Stockdale executed his bombing from a low level, causing much destruction. His fine fighting spirit and courageous example have been a source of inspiration.

THE KING has been graciously pleased to approve the following award in recognition of gallant conduct:—

Military Medal

Sgt. T. E. HEWITT, R.A.A.F., No. 150 Sqn.—After his aircraft had been disabled during a vigorous attack from 3,000 feet, Sgt. Hewitt was ordered to escape by parachute. Alighting in "no man's land" this airman sustained a painful injury to his ankle. He was unaware of his position and was fired at when he moved. The next day he saw his crashed aircraft about a mile away. In great pain and crawling mostly at night, he reached the aircraft four days later, having evaded several enemy patrols. After attempting to destroy everything possible in the aircraft, Sgt. Hewitt then managed to reach some huts from where he was rescued by our patrols six and a half days after abandoning his aircraft.

Sgt. (now P/O.) G. C. W. O'NEIL, R.A.A.F., No. 450 (R.A.A.F.), Sqn.—This airman effected a forced landing near Namman on July 25th, 1942, owing to engine failure, but succeeded in making his way back to the British lines. After making a low-level attack on the enemy near Churgia on January 13th, 1943, he was compelled to land many miles behind the enemy's lines. Despite machine-gun fire, he penetrated those lines and reached our forces four days later.

Roll of Honour

Casualty Communiqué No. 261.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 83 are second entries giving later information of casualties published in earlier lists.

Flt. Lt. H. C. Godefroy, R.C.A.F., awarded the D.F.C. He has two enemy aircraft to his credit.

Royal Air Force

KILLED IN ACTION.—F/O. M. B. Collings; F/O. F. W. Gates, D.S.O.; Sgt. H. C. Hooper; Flt. Sgt. G. Hough; P/O. J. P. Newton.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. H. W. Crock; Sgt. R. H. Fuller; Sgt. E. A. Hall; P/O. H. Kelly; Sgt. J. F. Oakley.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. A. Brace; Flt. Sgt. J. E. Bacon; Sgt. J. F. Baxter; Flt. Sgt. S. L. Beamont, D.F.M.; Sqn. Ldr. L. G. Belchem; Flt. Sgt. L. Blashill; Sgt. P. Bray; Sgt. F. V. Bretherton; Flt. Lt. E. H. Brown; Sgt. W. Bulman; P/O. E. E. T. Cattermull; Flt. Lt. W. A. H. Chapman; Sgt. C. W. Cooke; Sqn. Ldr. W. D. Corr, D.F.C.; Sgt. L. C. Craig, Sgt. E. V. Davey; Sgt. A. H. T. Davies; Sgt. T. P. W. Davies; Sgt. H. R. H. de Laspee; Sgt. R. J. Delve; P/O. I. P. Duxbury; Sgt. G. M. Edwards; Sgt. O. G. Edwards; Sqn. Ldr. F. C. C. Freeman; P/O. P. G. Frith; Sgt. W. E. Furness; P/O. L. R. Goad; Flt. Sgt. R. C. Graham; P/O. K. F. Harding; Sgt. S. H. Hughes; P/O. R. M. Lee; P/O. R. W. Medus; P/O. C. R. Morrison-Jones; P/O. H. R. Nash; Sgt. W. R. Norley; Sgt. R. T. Plant; Sgt. S. V. Price; Sgt. A. Riding; Sgt. T. S. Ross; Sgt. C. H. Stewart; Sgt. L. J. Symonds; Flt. Sgt. J. N. Tew; P/O. J. R. Tregea; Sgt. V. G. F. Walklin; Sgt. R. Wigham; Flt. Sgt. E. S. C. Williams; Flt. Sgt. G. J. A. Willis.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. S. R. M. Pugh.

WOUNDED OR INJURED IN ACTION.—F/O. S. N. Beason; Sgt. P. O. Neale; Sgt. P. A. Ratcliffe.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. R. G. Barham.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. C. Askham; Sgt. J. H. Body; Sgt. S. Brown; F/O. F. A. Clark; P/O. G. H. Dane; P/O. P. J. Dungar; Sgt. J. G. W. Fowles; Sgt. L. Jakes; Sgt. D. N. Law; Sgt. J. T. Murray; Sgt. W. A. Pasqual.

MISSING.—Flt. Sgt. E. W. Banks; Sgt. G. Batty; Sgt. T. E. Baxter; Flt. Sgt. H. Bell; Sgt. H. A. J. Berry; F/O. D. V. Bishop; Sgt. R. C. Boardman; Sgt. J. Booth; Sgt. J. W. Bousfield; Sgt. F. R. Bradbury; Sgt. A. T. C. Bromwich; Sgt. A. Brown; Sgt. C. E. Bryant; Sgt. R. A. Buck; Sgt. J. Burns; Sgt. A. S. Bushill; Sgt. J. E. Butt; Sgt. O. Cave; P/O. C. A. Cheese; F/O. J. Cookson; F/O. R. J. Coombes; Sgt. W. C. Digby; Sgt. E. R. Dixey; Sgt. M. L. S. Drabble; Sgt. A. L. Eastwick; Sgt. J. L. Edwards; F/O. K. A. Embery; Sgt. E. Esau; Sgt. N. H. Frank; Sgt. P. A. J. Gardner; P/O. F. Giles, D.F.M.; Sgt. F. L. R. Gilliver; Sgt. S. Godfrey; Sgt. A. F. Halsted; Sgt. K. C. Harrison; Sgt. V. H. Hatchard; P/O. J. B. M. Haye; Sgt. A. K. Haynes; Sgt. E. Hazelden-French; Sgt. K. G. Hoad; Sgt. G. J. Holt; Sgt. D. T. Horsfall; Sgt. H. W. E. Hyett; Sgt. W. Ibbotson; F/O. F. A. James; P/O. H. F. Jolley; Sgt. J. Jones; Sgt. L. W. Jones; Sgt. S. Jones; Sgt. W. G. Kirby; Sgt. A. F. Lane; Sgt. W. T. Lee; Sgt. J. Leedham; Sgt. J. F. B. Lester; Act. Flt. Lt. T. Luke; P/O. J. R. McCall; Sgt. G. L. McCarthy; P/O. F. D. L. McIntyre; Sgt. A. G. McManus; Sgt. J. D. Mahony; P/O. W. A. Marsden; Sgt. A. J. Marshall; F/O. L. C. Martin; Sgt. R. C. Miles; Sgt. J. D. Minton; Sgt. J. D. Muir; Sgt. N. K. Newham; Sgt. C. Newman; Sgt. L. W. Nichols; Sgt. G. F. Parris; Sgt. D. Parry; Sgt. D. A. F.

SERVICE AVIATION

Paveley; F/O. J. Phillips; Sgt. A. J. Polfrey; Sgt. G. H. Potter; Sgt. N. Potts; Act. Flt. Sgt. T. J. Pritchard; P/O. C. Power; F/O. W. D. Rail; Sgt. C. W. Roberts; F/O. G. R. Royde, D.F.C.; Sgt. C. F. Saville; Sgt. J. Shields; F/O. E. G. Simonds; Sgt. A. B. Stevenson; Sgt. J. C. Stewart; Act. F/O. G. A. Stillingfleet; Sgt. L. A. Stimpson; P/O. D. C. Stone; Flt. Sgt. J. Talbot; Sgt. C. Taylor; Sgt. N. K. Underwood; Flt. Lt. H. D. Van Der Linden; Act. Flt. Lt. L. Verdon-Roe, D.F.C.; Sgt. R. S. A. Walker; Sgt. J. W. Waters; Sgt. D. E. Watts; Flt. Sgt. J. D. White; Sgt. H. G. Williams; Sgt. R. A. Williams; Sgt. R. F. Williams; Act. Flt. Lt. J. M. Williamson; F/O. S. A. Willoughby; Sgt. G. S. Wishart; Sgt. C. E. Wright; Sgt. L. A. Wright; Sgt. G. A. Yeo; Sqn. Ldr. H. M. Young, D.F.C.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. S. Sabin.

KILLED ON ACTIVE SERVICE.—Sgt. F. T. Allen; Sgt. J. Arkle; Sgt. E. J. Ashton; Sgt. E. J. Beer; Sgt. E. E. Blumfield; Sgt. A. Campbell; Cpl. W. F. Cooke; F/O. R. G. Crouch; Flt. Sgt. R. Davidson; A/C.2 P. Dorrington; Sgt. W. Dove; L.A/C. G. Drew; L.A/C. E. F. Eastlake; Sgt. L. C. W. Finlayson; L.A/C. H. C. Halestrap; L.A/C. L. S. Hall; Sgt. J. S. Harris; F/O. F. Hilton; F/O. J. C. N. Lewis; P/O. E. W. McClelland; Sgt. W. Mycock; Sgt. P. J. Phipps; Sgt. R. C. Quinney; Sgt. W. Simpson; F/O. K. A. Stevenett; Cpl. H. G. Sylvester; F/O. G. A. Warde; Sgt. A. Williams; Sgt. C. R. S. Williams; Sgt. F. W. Wilson; Sgt. J. H. L. Wilson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. E. C. Craddock.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. H. Potkins; Sgt. D. Smith; L.A/C. J. W. Tucker.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—F/O. E. B. Blackburn; L.A/C. T. H. Hunt; L.A/C. A. Telford; Sgt. A. W. Thomson.

DIED ON ACTIVE SERVICE.—A/C.1 C. E. Chambers; A/C.2 E. Densham; Sgt. A. R. Denzey; A/C.1 K. J. Harris; L.A/C. W. A. Kirkham; Sgt. H. Lancaster.

PREVIOUSLY MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. R. G. Bacon; Flt. Sgt. F. E. Bailey; Sgt. C. L. Blackford; Sgt. F. J. Brotherton; Sgt. L. Calarossi; Sgt. B. Catlin; Sgt. W. Cook; Sgt. T. N. Davidson; Sgt. J. Henzell; Sgt. W. C. Nicholson; Sgt. F. C. Phillips.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. R. A. Armitage.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. E. Dewhurst; Sgt. N. J. Owen.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. T. D. Belford; P/O. K. F. Lloyd-Jones.

MISSING, BELIEVED KILLED IN ACTION.—F/O. W. R. Cleland; Sgt. R. W. Dowell; F/O. D. J. Hickey; Sgt. I. Hunter; Flt. Sgt. A. C. Johnston; Sgt. P. McCombie; P/O. E. S. MacKenzie; Flt. Sgt. N. R. Mason; Sgt. R. S. Moore; F/O. V. J. Palston; Sgt. N. D. Pollock; Flt. Lt. D. Saunders; F/O. G. L. T. Smith; Sgt. G. M. Walker; P/O. W. M. Wendon; Flt. Sgt. R. G. Wynn.

MISSING.—Sgt. T. J. Brassel; Sgt. H. A. J. Cummings; Sgt. E. T. Horner; F/O. W. Lawrence; Sgt. O. P. Morton; Sgt. A. D. M. Ross; Sgt. N. T. Sparrow.

KILLED ON ACTIVE SERVICE.—Sgt. J. A. Douglas; Sgt. R. N. Kemsley; Sgt. C. B. Wootten.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. R. F. Gauvin.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. L. O'G. Warner.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. G. C. Evans; Flt. Sgt. J. S. D. H. Gosselin; Flt. Sgt. A. H. Gudgeon; P/O. D. G. Reid, D.F.M.; Flt. Sgt. A. Stelman.

WOUNDED OR INJURED IN ACTION. — Sgt. W. D. G. Merlin; P/O. C. L. Outhouse.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. D. O. Broughton.

MISSING.—Sgt. W. Brown; Flt. Sgt. K. Clark; P/O. P. B. Code; Sgt. J. A. Coughlin; P/O. F. A. Doherty; P/O. J. L. Drysdale; Sgt. R. C. Ferguson; Sgt. H. P. Fudge; Sgt. G. B. Leadbeater; F/O. V. S. MacCausland; Sgt. A. D. McKim; Flt. Sgt. T. M. Moran; P/O. W. R. Post.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. W. R. Taggart; Sgt. L. A. Wearn.

KILLED ON ACTIVE SERVICE.—W/O. A. W. Otto; L.A/C. P. Piotrofsky.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. R. M. Reisner.

DIED ON ACTIVE SERVICE.—P/O. H. B. Tucker.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt D. R. Chalmers; F/O. R. D. McAdam; W/O. G. C. Onyette; Sgt. H. S. Young.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. J. E. S. Bentley; Flt. Sgt. L. R. Feasey; F/O. W. L. Kauter; Flt. Sgt. C. H. Mulholland; P/O. W. G. D. Thurston; F/O. A. G. B. Williams.

MISSING.—Sgt. C. H. Brumby; Sgt. T. B. Rimmer.

KILLED ON ACTIVE SERVICE.—F/O. A. D. V. Forsyth.

Casualty Communiqué No. 262.

Of the names in this list 101 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—P/O. J. B. McLeod; F/O. N. J. Miller.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. G. G. Chalmers; Flt. Sgt. R. S. Coles; Sgt. F. C. Easterling; P/O. R. A. Hanagan; Sgt. A. P. Jamieson; Sgt. P. J. Maxwell; Sgt. A. G. Sale; P/O. W. J. Smith; Sgt. T. Thompson; Sgt. R. J. Thomson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. J. Abram; Sgt. J. L. Abson; F/O. W. J. E. Ardley; Sgt. C. Atchison; Sgt. A. J. Beattie; Flt. Sgt. J. H. Bentley, D.F.M.; Sgt. F. G. A. Bick; P/O. L. A. Booth; Flt. Sgt. P. E. Bull, D.F.M.; Sgt. N. A. Burroughs; Sgt. M. H. Burtt; Act. Sqn. Ldr. F. de B. Collenette; Flt. Sgt. J. S. Cooper; Flt. Sgt. G. H. P. Dean; Sgt. A. S. Douglas; Sgt. H. G. Edge; Sgt. F. E. Flint; P/O. J. N. Eslick; Sgt. J. Flockhart; Sgt. J. Forsyth; Sgt. F. G. Fox; P/O. J. W. Fraser; Flt. Sgt. F. G. Fry; Sgt. H. A. George; Sgt. H. J. Gill; Sgt. S. M. Girvin; Sgt. H. Clegg; Sgt. W. F. Gray; Flt. Sgt. R. H. Groom; Sgt. A. T. Grossmith; Act. Sqn. Ldr. A. E. Hacking; F/O. H. C. Hain; P/O. H. W. Harrison; Sgt. G. Hazan; P/O. J. L. Hicks; Sgt. G. L. Hodson; Sgt. H. Hole; Sgt. W. R. Hopkins; Sgt. J. S. Jarvis; Sgt. D. M. Jones; W/O. G. J. Kerrigan; P/O. N. S. King; Flt. Sgt. W. A. Lack; Flt. Lt. W. M. Livingston; Flt. Sgt. G. B. Lukhmanoff, D.F.M.; Sgt. A. Lyle; Sgt. K. M. McGregor; Sgt. E. W. Margetts; P/O. G. P. Marshall; P/O. J. E. Marshall; Sgt. R. T. C. Martin; Flt. Lt. C. W. Miller; Sgt. D. J. Miller; Sgt. R. Oxley; Sgt. R. L. Prosser; Sgt. D. E. Raymond; Flt. Lt. V. A. Ricketts, D.F.C.; P/O. F. A. Scott; Sgt. W. D. Scott; Sgt. E. J. Simmons; Flt. Lt. F. Spicer; Flt. Sgt. E. W. Spiller; Sgt. L. G. Still; Sgt K. C. Swaby; P/O. J. R. Thornton; Sgt. L. M. Washer; Sgt. V. O. Weston; Sgt. C. J. Whalley; Flt. Sgt. T. R. Whitehead; Flt. Sgt. A. E. Williams; P/O. A. Ydlibi; Sgt. L. A. York.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. L. A. Montgomery.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. R. J. Fowler; Sgt. J. Palmerley; Sgt. L. F. Paterson; Flt. Sgt. D. R. N. Reynolds.

MISSING.—Sgt. D. E. Alford; Sgt V. H. Archer; Flt. Sgt. G. Bell; Sgt. F. W. Bennett; Sgt. J. W. S. Birrell; Sgt. R. S. Blake; Sgt. J. H. Casstles; Sgt. T. Chalmers; Sgt. W. V. Chambers; Sgt. A. Chilton; Sgt. T. B. Clark; Sgt. W. R. L. Codd; Sgt. N. S. Collins; Sgt. W. R. Cook; Sgt. J. R. Cranham; F/O. J. M. Crawford; P/O. L. R. Crocker; Flt. Sgt. R. Cross; Sgt. G. T. Davies; Flt. Lt. D. J. Dawson; Sgt. J. Dodd; Sgt. P. G. Eames; Sgt. J. P. Egan; Act. Flt. Lt. J. G. Eldridge, D.F.C.; Sgt. G. D. Evans; Sgt. J. W. C. Evans; Sgt. A. W. Fincham; Sgt. J. F. Forsythe-Johnson; Sgt. L. G. Freeman; Sgt. J. K. Fulton; Sgt. J. H. Griffiths; Sgt. J. L. Hamilton; Sgt. R. H. Harris; P/O. W. A. Hockey; Sgt. H. T. G. Hubbard; Sgt. S. B. Jobes; Sgt. R. E. L. Johnson; Sgt. C. Jones; Sgt. B. McM. Jubb; Sgt. J. Kershaw; Sgt. W. J. Ledbury; Sgt. K. G. Legg; Sgt. R. Lewis; F/O. P. H. Liddle; Sgt. G. P. Lister; Sgt. D. Littlewood; Sgt. B. H. Lowe; Sgt. J. R. McLeod; Sgt. A. McQuater; Sgt. L. Martin; P/O. R. Massie; Sgt. D. Maynard; Sgt. R. S. G. Miller; Flt. Sgt. W. D. Mills; Sgt. H. W. Moore; Sgt. S. Moore; P/O. J. E. Morris; F/O. W. N. Mounsey; Sgt. F. J. North; P/O. R. Paisley; Sgt. J. Park; Sgt. E. V. Pass; Sgt. J. H. Pickles; Sgt. H. Pierpoint; Sgt. F. H. E. Pooley; Sgt. S. Redpath; Sgt. L. W. Rees; Sgt. J. W. Richardson; P/O. D. W. Robinson; Sgt. H. Roots; Sgt. J. P. Roughan; Sgt. J. F. Sanders; Flt. Sgt. J. A. Saunders; Sgt. W. R. Scott; Sgt. D. Seigal; Sgt. C. H. Sherwood; Sgt. E. G. M. Smith; Sgt. S. Smith; Sgt. B. Spencer; F/O. A. E. Steward; Sgt. J. H. Steward; P/O. D. P. Stokes; P/O. R. J. M. Stradling; Sqn. Ldr. D. C. Sturrock; P/O. A. R. H. Sullivan; F/O. G. G. Taylor; Sgt. R. K. Tewfik; P/O. J. T. Toswill; P/O. J. B. True; Flt. Lt. J. A. Twentyman; Sgt. J. H. Waterston; Act. F/O. W. P. Wellington; F/O. W. B. Whitaker; Sgt. J. C. L. Whiteman; Sqn. Ldr. C. C. Wigram; Sgt. F. P. Willsher; Flt. Sgt. J. W. Wilmore.

KILLED ON ACTIVE SERVICE.—Sgt. R. Allan; Sgt. P. A. Allport; Sgt. S. R. Barnes; Sgt. F. W. Barns; Sgt. R. G. Carter; Sgt. J. J. Cooper; Sgt. A. Edgar; Sgt. M. Edwards; Act. Sqn. Ldr. D. Evans; L.A/C. S. Goddard; F/O. G. M. Gray; Sgt. B. Grimes; Sgt. H. H. C. Harris; P/O. F. J. Jessop; Sgt. A. R. Marlow; Sgt. D. W. Mason; F/O. K. R. Mason; P/O. A. I. T. Moir, D.F.C.; Sgt. J. B. Norman; A/C.2 D. H. O'Brien; Flt. Lt. N. Parry; Sgt. L. R. Perrins; F/O. H. Rathbone; Sgt. K. J. Roberts; Sgt. G. A. Shearer; L.A/C. T. K. J. Simpson; P/O. H. G. A. Thompson; Flt. Sgt. D. J. Underwood; L.A/C. D. V. Waddams; L.A/C. N. Wood; Act. Sgt. S. R. Yeoman.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. N. W. Callister.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. D. C. H. Copping; Flt. Lt. R. D. Crofton.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. A. H. Bracey; Sgt. J. A. Clark; F/O. J. C. Kay; A/C.2 S. L. Perry; Flt. Sgt. I. V. Peters; Sgt. A. D. Roscoe; A/C.1 J. Stevenson; Sgt. R. W. Taggart; L.A/C. F. Taylor.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. K. S. Hunt; L.A/C. E. B. Jones.

DIED ON ACTIVE SERVICE.—L.A/C. P. W. Baker; A/C.2 J. F. Convoy; Cpl. K. G. Coulter; F/O. D. P. Higgins; A/C.1 A. E. Maynard; L.A/C. R. E. Plowright; Cpl. E. Smith.

Women's Auxiliary Air Force

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/CW. L. S. Ellis; L.A/CW. E. G. Reynolds.

DIED ON ACTIVE SERVICE.—A/CW.2 C. L. Allen.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. E. Carson; Sgt. E. J. Lawer; Sgt. N. L. Smith; P/O. H. G. Waddell.

MISSING.—Flt. Sgt. A. Barnes; F/O. V. J. Coreless; Sgt. T. H. Doran; W/O. C. L. Edwards; Sgt. J. Egan; Flt. Sgt. J. H. T. Hayes; Sgt. J. H. Hore; F/O. R. G. Bowley, D.F.C.; Flt. Sgt. J. E. Jackson; Flt. Sgt. J. C. Kelly; Sgt. R. A. Kerr; Act. Flt. Lt. M. K. McKenzie; P/O. N. A. McLeod; L.A/C. J. Murdock; Flt. Sgt. J. M. Parsons; Flt. Lt. T. W. C. Patrick; Sgt. J. A. Pearce; F/O. K. L. Ridings; Flt. Sgt. D. Ross; Flt. Sgt. D. L. Wallace; P/O. K. C. Wathen; Flt. Sgt. J. B. Whyte.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Flt. Sgt. J. S. Freeth; F/O. I. H. Whitson.

KILLED ON ACTIVE SERVICE.—P/O. G. N. J. Bryde; Sgt. D. M. Gibson; Sgt. C. L. Harris; Sgt. C. Nelson; Sgt. D. E. Veness

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. C. H. R. McKee; Sgt. D. Morgan.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. E. H. Brabender.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. A. B. Douglas; Sgt. S. D. Frewen; Sgt. A. J. Grenon; Sgt. A. J. Simpson; P/O. F. L. Flynn; Flt. Sgt. J. G. Forbes; Flt. Sgt. T. J. Hannah; Sgt. B. D. Nidelman; Flt. Sgt. W. J. Porritt, D.F.M.

WOUNDED OR INJURED IN ACTION.—Sgt. W. N. MacEachern; Sgt. J. C. J. L. Tremblay.

MISSING.—P/O. A. F. Beaton; Sgt. J. N. P. E. Comeau; Sgt. O. H. Gibson; Sgt. D. R. Gilchrist; Act. Flt. Lt. J. A. Guest; Sgt. G. G Hart; Sgt. C. G. Kernaghan; Sgt. J. C. Lamond; Sgt. J. F. R. Laurence; Sgt. D. W. MacFarlane; Sgt. G. F. P. O'Hara; Sgt. J. F. Selman; Sgt. L. G. Smith; Flt. Lt. H. R. Sutton, D.F.C.; Act. W/O. D. H. Thompson; Sgt. J. V. J. R. Veys; P/O. H. M. Wygle.

KILLED ON ACTIVE SERVICE.—Sgt. H. R. Downing; Sgt. R. E. Manser; P/O. R. K. Van Cleaf.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. G. L. Bonne.

MISSING, BELIEVED KILLED IN ACTION.—F/O. C. F. Blanchard.

MISSING.—Flt. Sgt. J. E. Clarke; Sgt. D. D. Coates; Flt. Sgt. T. W. Darton; F/O. W. V. Fitzgerald; Flt. Sgt. H. A. Lister; Flt. Sgt. G. A. Mathias; F/O. H. D. Pye; Sgt. J. M. P. Riordan; Flt. Sgt. I. M. Sykes; Sgt. J. K. Wilkins.

KILLED ON ACTIVE SERVICE.—Sgt. P. R. S. Miller; Sgt. A. R. Davis.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. K. T. Devery.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—F/O. H. R. Leckie; Sgt. F. Mangleson.

South African Air Force

WOUNDED OR INJURED ON ACTIVE SERVICE.—Lt. J. B. Ellis.

1943